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Division of Farm Management and
Agricultural Economics

Economic Aspects of Apple
Production in Washington

by
Neil W. Johnson



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¹In cooperation with the State Committee on the Relation of Electricity to Agriculture.

²In cooperation with the United States Department of Agriculture.

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2. Yakima Fruit Growers Association
3. Wenatchee District Cooperative Association

Local Units at:

Wenatchee	Dryden
Monitor	Peshastin
Cashmere	Entiat

4. Wenatchee-Okanogan Cooperative Federation
5. Sunnyslope Fruit Exchange
6. Montor Federated Growers
7. Cashmere Fruit Growers' Union
8. Peshastin Fruit Growers' Association
9. American Fruit Growers, Inc., Wenatchee
10. Wenatchee Skookum Growers
11. Cashmere Skookum Growers, Inc.
12. Dryden Skookum Growers
13. Peshastin Skookum Growers
14. Rock Island Skookum Growers
15. Northwestern Fruit Exchange
16. Interstate Fruit Growers, Inc.
17. Orondo Community Packing Plant

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Helpful suggestions were received from Professor Geo. Severance, Chester Hampson, and Edwin Landerholm of this department and from Professors O. M. Morris, J. R. Magnus, and E. L. Overholser of the Department of Horticulture.

Mr. H. R. Carlson obtained most of the data from the records of the grower organizations and calculated each grower's cost of production for the entire three years of the study. His handling of the intricate details of cost was very accurate and efficient.

A word of appreciation is due over two hundred growers who cooperated with fine spirit in furnishing details of their farm costs and operations for three successive years.

SUMMARY

Approximately one out of every four apples purchased by consumers in the United States is a Washington apple.

The barrelled-apple states are rapidly improving in methods of management and are planting many of the varieties of chief commercial importance in Washington.

Planting trends for the United States indicate a gradual increase in production in the future. Western states show very little planting activity, while plantings in Washington are but little greater than those necessary to maintain the present bearing acreage.

Washington is steadily increasing the plantings of the Delicious variety. In view of extensive Delicious plantings in the East, this situation is not entirely satisfactory.

Despite yearly fluctuations, the Yakima and Wenatchee growers studied were making satisfactory returns on their invested capital and the maximum cash available for family living averaged over \$2000 yearly per orchard in each District.

Moderate investments, high yields, popular varieties, and the production of high quality fruits were found to be factors in the success of the most profitable farms.

The three year (1926-'28) average cost of producing a box of apples on 81 farms in the Wenatchee District was \$1.171 per box. Returns over this period averaged \$1.291, leaving a net profit of 12 cents per box or \$64.57 per acre on the average per acre yield of 535.6 boxes. The average cost of \$1.171 per box includes interest on all investments and wages for all labor whether hired or performed by the family, but no depreciation on the orchard planting.

Depreciation on the orchard planting added slightly over seven cents per box to the cost.

Deducting all interest charges from the cost figures the average return above cost provided a 10 to 11 per cent return on the capital invested in apple production on the orchards studied in both districts.

The three year average cost on 17 large manager operated orchards in the Wenatchee District was \$1.436 per box with receipts of \$1.219 per box. The loss was largely due to low yields, less desirable varieties, and the necessity for hiring ALL work done in even the poor year.

The three year (1926-'28) average cost on 43 orchards planted only to apples in the Yakima District was \$1.048 per box. Returns averaged

\$1.179 leaving a profit of 13.1 cents per box or \$63.45 per acre on the average yield of 484.45 boxes.

The three year (1926-'28) average cost on 43 orchards containing filler trees in the Yakima District was \$1.062 per box. Returns averaged \$1.207 leaving a profit of 14.5 cents per box or \$66.63 per acre on the average yield of 459.90 boxes.

Depreciation on the apple planting in the Yakima District added six cents per box to the average cost.

Yearly returns fluctuated four to five times as violently as did production costs in either district.

Production costs are divided into fixed and variable costs depending on whether the cost is affected by changing yields. Fixed costs made up 42.52 per cent and variable costs 57.48 per cent of the average cost of production on the orchards studied in the Wenatchee District.

Under present conditions the efforts of the grower are primarily effective in cost reduction when devoted to the labor of growing the crop and delivering it to the warehouse; these items constitute less than 30 per cent of the cost of a packed box of fruit.

In the Wenatchee District 70 cents per box would approximate the actual cash expenditure in producing and packing a box of apples.

Yields and prices are two of the most important factors in determining the profit per box.

Costs of production may be reduced by keeping all investments as low as possible, by securing high yields through normal methods, by comparisons of ones own costs with the average for his district and by keeping alive to the economies being effected by other growers.

Both yield per tree and returns should be considered in determining the most profitable varieties.

Based on average costs and returns Delicious, Winter Banana, Winesap, Arkansas Black, and Yellow Newtown are capable of returning a profit to the average grower, while Grimes Golden, Black Twig, Black Ben and Ben Davis are almost certain to be produced at a loss.

The best size or orchard is determined by conditions on each ranch. Amount of family labor, condition of orchard, location, varieties produced, amount of risk one is willing to take and many other factors enter into the decision

ECONOMIC ASPECTS OF APPLE PRODUCTION IN WASHINGTON

By
NEIL W. JOHNSON

THE OUTLOOK FOR THE WASHINGTON APPLE INDUSTRY

The General Situation

While apples are produced throughout a wide area of the United States, over 80 per cent of the average commercial production for the years 1922-'28, was centered in the 12 states shown in Figure 1.

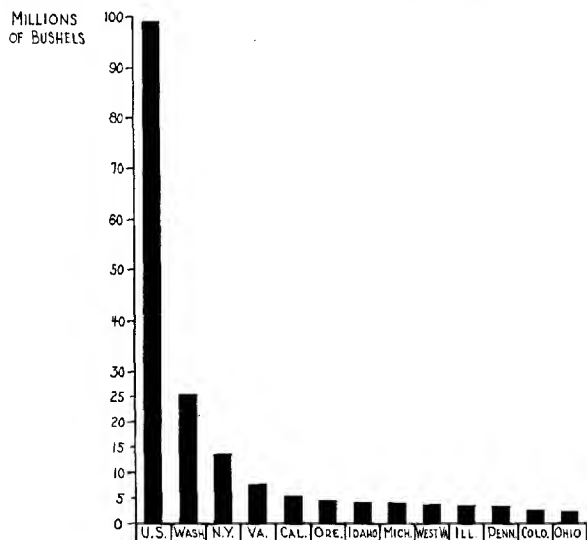


Fig. 1. Average commercial apple production in the twelve leading states during the period of 1922-'28.

Over 42 per cent of the U. S. commercial crop was produced, during this period, by the five western states shown in Figure 1 and Washington easily ranked first with an average production of 25.62 per cent of the nation's commercial crop. Approximately one out of every four apples purchased by consumers in the United States is a Wash-

ington apple. Preliminary figures of the United States Department of Agriculture credit Washington with a commercial production in 1929 of 24,900,000 bushels or over 243 per cent of the 1929 commercial production of New York.¹ New York ranks second only to Washington, supplying over the six year period (1922-'28) 13.73 per cent of the commercial apple crop of the United States.

"The Agricultural Outlook for 1930," published by the Bureau of Agricultural Economics says,

"As indicated in the 1929 outlook report, commercial production of apples for the country as a whole probably will continue to increase gradually for several years. However, the apple industry has recovered largely from the disturbed conditions which accompanied the rapid expansion of plantings in the Northwest and elsewhere, 20 to 25 years ago, and the rate of increase in commercial production is expected to be less than during the years when these plantings affected production most. The extent to which the industry has recovered and the tendency toward more moderate plantings in recent years is encouraging to the efficient commercial grower who produces fruit of high quality. But the large number of relatively young trees now planted indicates an increase in commercial production over a period of years as well as heavy production and low prices when weather and other growing conditions are especially favorable throughout the apple areas."

"According to an apple-tree survey made in 33 states, which produce over 90 per cent of the United States apple crop, from 25 to 30 per cent of the trees in commercial orchards reported were less than 9 years old at the beginning of 1928 and 65 to 70 per cent were under 19 years old at that time."

"In the barreled-apple states recent commercial plantings have been fairly heavy and at the beginning of 1928 about two-thirds of the trees reported in the survey of commercial orchards were less than 19 years old and nearly one-third were under 9 years. The pronounced movement toward better management of commercial orchards easily may become a factor of increasing significance, and contribute materially to the bearing capacity of the commercial orchards in the barreled-apple states."

The Situation in the Leading Western States

In the West, Oregon reported 48,565 acres in apples in 1920 and a decrease to 40,000 acres by 1928. The federal agricultural statistician for Oregon states that there is "practically no non-bearing acreage of apples in Oregon."

California reports 57,440 acres in bearing in 1929 and 5,944 acres of non-bearing apples. Taking California's bearing apple acreage in 1925 as 100 per cent there was only a 3½ per cent increase in bearing acreage by 1929.

¹Crops and Markets, Dec., 1929, Vol. 6, number 12, page 472.

The state horticulturist for Colorado reports 1,110,000 apple trees or approximately 16,386 acres in 1929, of which 95 per cent were bearing. Between 200,000 to 300,000 trees have been removed in recent years with Colorado apple production remaining nearly stationary for the last 15 years. Young trees coming into bearing have offset the losses from removals.

The 1925 census gives the latest available data for Utah, listing 558,106 bearing trees and 104,620 non-bearing or approximately 8,239 acres bearing and 1,544 acres non-bearing. The non-bearing acreage in 1925 was 15.79 per cent of the total apple plantings in Utah.

According to the 1925 census, Idaho had 1,760,648 bearing trees and 127,894 non-bearing or about 25,991 acres bearing and 1,888 acres non-bearing. The non-bearing acreage was 6.77 per cent of the total planting in 1925.

Table 1 is compiled from recent censuses taken by the district horticultural inspectors in the main apple producing sections of the state.¹

Table 1. Washington Apple Situation for Selected Counties†
(67.74 trees per acre)

County	Non-bearing trees			Bearing trees 8 years and older	Total trees
	1-2 years	3-4 years	5-7 years		
Chelan	65,891	72,465	26,438	1,198,936	1,363,730
Douglas	14,821	10,666	23,045	333,945	382,477
Grant	1,425	1,148	2,781	130,968	136,322
Okanogan	43,768	38,338	58,728	339,271	480,105
*Yakima--Kittitas	77,528	56,489	80,780	768,149	982,946
Total trees	203,433	179,106	191,772	2,771,269	3,345,580
Per cent of total planting by periods	6.08	5.35	5.74	82.83	100.00

†Chelan, Grant and Southern Douglas County census was taken to include the 1928 crop year. Okanogan, Northern Douglas, Yakima and Kittitas County census was taken to include the 1929 crop year.

*Preliminary figures and only a partial enumeration.

¹Tree census material supplied by District Horticultural Inspectors, Wendell P. Brown, George E. Harter and Harold Bliss.

The counties listed in Table 1 contained 63.93 per cent of the state's apple trees in 1924 and undoubtedly a much higher percentage of the entire state production. The table shows over 82 per cent of the trees in these counties to be of bearing age with approximately enough young trees being planted to maintain the bearing acreage.

Growers are not in accord as to the commercial length of life of the apple tree. Under irrigated conditions and "forcing" methods of production, the span of life of the trees is necessarily shortened. As trees grow older the apples produced tend to become smaller in size. This is a distinct limitation where returns on larger sizes are necessary to offset high production costs. For this reason trees are sometimes removed while still seemingly in a vigorous state of health. The limit of the **profitable** life of a tree is often reached before the end of its **actual** life. Under these conditions but few growers estimate the profitable life of the apple tree beyond 40 years and an increasing number would place it as low as 25 years.

Assuming a 35 year life, 2.86 per cent of any planting would need to be replaced each year to maintain the orchard. On this basis, the counties in Table 1 have planted 19,505 trees or 288 acres beyond the number necessary to maintain the bearing acreage of 1929. Since this is an increase of less than one per cent, it is seen that Washington orchards are doing little more than holding their own. During the past few years there has been widespread removal of bearing trees of the less desirable varieties in Washington. It is probable that the present rate of planting will be sufficient to insure a small but steady increase in bearing acreage when the wholesale removal of poor varieties is accomplished.

Concentration Into Few Apple Varieties in Washington

The history of predominant apple varieties in Washington has been one of constant change. Figure 2 illustrates the shifting popularity of varieties since 1885.

In the 10 year period, 1885-'94, nearly all the plantings in Washington were to varieties now of little commercial importance. During the next 10 year period, 1895-'04, Delicious, Winesap, Rome Beauty and Jonathan were prominent in the new plantings while a large number of other varieties were being planted on a less extensive scale. In the 1905-'14 period over 77 per cent of all plantings were confined

to Delicious, Winesap, Rome Beauty and Jonathan; each variety having made substantial gains over the previous 10 year period. During 1915-'24 these same four varieties constituted over 86 per cent of the new plantings but Jonathan, Rome Beauty and Winesap had decreased in popularity while Delicious had increased until it had more than offset all the losses sustained by the other three main varieties. Plantings in the 3 year period, 1925-'27, were concentrated largely in the Delicious and Winesap varieties. During this period 47.56 per cent

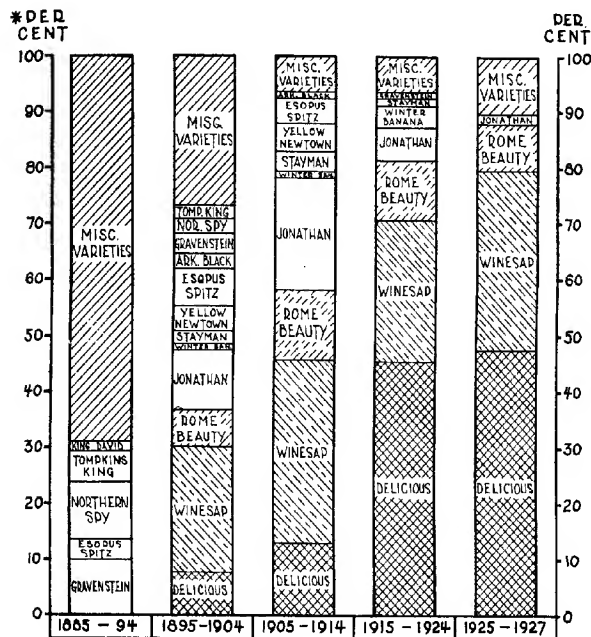


Fig. 2. Washington Apples. Relative importance of each variety to total plantings during successive time periods. All varieties making up less than one per cent of the total planting for the period have been listed as "Miscellaneous Varieties."

of the plantings were to Delicious and 32.09 per cent to the Winesap variety. The Jonathan due to adverse price conditions constituted only 1.64 per cent of the 1925-'27 plantings and the Rome Beauty made

up 8.32 per cent. Plantings since 1927 have undoubtedly been concentrated even more in the Delicious variety.

Mr. M. R. Cooper, Senior Agricultural Economist of the Bureau of Agricultural Economics, says on the Delicious situation,

"The Delicious is prominent on the Coast, in the Central states, in the Cumberland-Shenandoah region, in New Jersey, in Delaware, in New England, and in New York. The future for this variety is not entirely clear since the trees in some districts have not been planted long enough to determine their producing capacity. It is evident, however, that if these trees produce well in the Central and Eastern States there will be a large increase in production of the Delicious apple within the next five or ten years and the relatively high price now paid for this variety may be reduced."

Figure 3 shows the trend since 1895 in plantings in Illinois, New York and Washington of four of the most important commercial apple varieties in Washington.

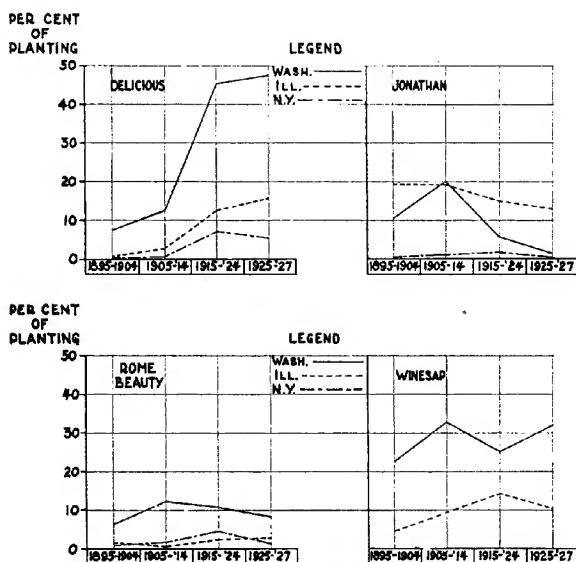


Fig. 3. Planting trends since 1895 for Delicious, Rome Beauty, Jonathan and Winesap in Washington, Illinois and New York.

Plantings in Washington of the Delicious and Winesap are shown

to be on the increase while decreases are indicated for the Jonathan and the Rome Beauty.

Illinois shows a tendency to increase the Delicious variety, which comprised over 15 per cent of the state plantings during the 1925-'27 period. An upward trend in production of the Rome Beauty is shown, with decreases in plantings of both the Jonathan and Winesap varieties.

New York showed increases in plantings of the Delicious and Rome Beauty till the 1925-'27 period when their importance in relation to other varieties suffered a set back. The Jonathan is also shown on the decrease. No figures were available on the Winesap situation in New York state.

Quoting from the "Agricultural Outlook for 1930,"

"Plantings of a few years ago in the East show a decided shift to such varieties as the Delicious, McIntosh, Jonathan, Stayman-Winesap, Winesap and Yellow Transparent. Apples of these 6 varieties constituted 43 per cent of market supplies in the 1926 season, according to a survey of 41 cities in the United States, and the large number of young trees of these varieties indicate increasing production for several years."

Table 2 presents the variety situation in 22 states which contain 74 per cent of the bearing apple trees and supply 81 per cent of the entire United States production.

Table 2. *Apple Trees of Specified Varieties in Commercial Orchards in 22 States, Percentage of All Trees and Age of Trees of the Variety, 1928.

Variety	Percentage of all trees†	Percentage of designated variety		
		8 years and under	9 to 18 years	19 years and over
Winesap.....	9.8	24.1	51.8	24.1
Delicious.....	8.3	56.7	38.7	4.6
Baldwin.....	7.6	14.7	23.2	62.1
Jonathan.....	7.3	29.2	48.5	22.3
Stayman Winesap.....	6.0	39.9	49.8	10.3
Ben Davis.....	4.9	6.8	16.5	76.7
Rome Beauty.....	4.4	21.2	62.1	16.7
Yellow Newtown.....	4.1	5.1	31.9	63.0
McIntosh.....	3.8	61.3	33.1	5.6
Yellow Transparent.....	2.5	56.8	31.8	11.4
Gravenstein.....	2.3	18.5	50.0	31.5
Other Varieties.....	39.0	.....	.....	.....

†64,945,000 trees equals 100 per cent.

*Taken from an article by M. R. Cooper, "Outlook for the Apple Industry"—Journal of Farm Economics—Jan., 1929.

The Winesap and Delicious are the two varieties of greatest importance over this vast territory, followed closely by Baldwin and Jonathan. It is significant to note that 24.1 per cent of all the Winesaps, 56.7 per cent of all the Delicious, 29.2 per cent of all the Jonathans and 21.2 per cent of all the Rome Beauties were still non-bearing in these 22 states in 1928.

With Washington's main commercial varieties rapidly gaining prominence in the East and other producing areas, it behooves the Washington grower to consider the wisdom of complete concentration in the production of but one or two main varieties of apples. In apple growing the acme of risk taking would seem to be the production of a single variety. While a "baker's dozen" of varieties would be equally undesirable the grower would take less risk in producing at least two and possibly three or four of the best varieties. Many of the varieties removed in the past few years have been "good riddance of bad rubbish," but the grower should think twice before removing varieties which are good keepers and produce high yields of good quality fruit.

It would appear that additional commercial plantings are justified only where favorable conditions exist for production at lower than average costs.

YEARS EMBRACED BY THE STUDY

This study was conducted over the years of 1926, 1927 and 1928. The 1926 crop year was an unprofitable season for the average Washington apple grower. Climatic conditions were exceptionally favorable all over the apple producing areas of the United States. As a result, the 1926 crop was the second largest produced since 1906, being exceeded in size only by the 1914 crop. A heavy frost occurred in Washington during the early part of the harvest season causing many of the ripened apples to drop from the trees. Under Washington's stringent rules for marketing only high quality fruit these apples were, for the most part, a total loss, thus materially lowering the yield of marketable fruit.

Due to the severity of the frost, grave fears were experienced for the keeping quality of the fruit and a large part of the crop was moved quickly to market in September, October and November, where it was sold for whatever it would bring on an already crowded market.

The 1927 crop year was as favorable for the Washington grower as the preceding year had been unfavorable. The eastern barreled apple districts suffered a crop failure; New York's commercial production being only 45 per cent of its 1926 commercial crop. The 1927 commercial crop of the entire United States was only 66.21 per cent of the 1926 commercial crop. As a result northwestern boxed apples sold on the average at 75 cents to \$1.00 per box higher throughout the season than in 1926. Although many Washington orchards had been allowed to bear very heavily in 1926 resulting in a short crop in 1927, the yield obtained by most growers, was sufficient when coupled with abnormally high prices to net a very satisfactory return.

The conditions for the 1928 crop year fell somewhere between those prevailing in 1926 and in 1927. The commercial crop of the United States was 30 per cent heavier than in 1927. Washington was characterized by exceptionally heavy production while yields in the East were only moderate. Returns to the Washington grower were lower than in 1927, but not as poor as returns in 1926. Growers on the better orchards made reasonable profits while those on poorer tracts failed to break even.

METHOD OF THE SURVEY

Approximately two hundred apple growers were interviewed for the three successive years of this study. Half these men were located in the main apple producing areas of the Yakima Valley and half in the most important producing centers of the Wenatchee District. Each grower gave a record of the cash outlay in operating his farm the preceding year and estimated the labor involved in producing the apple crop. The grower's marketing organization was visited and a detailed record of his returns by variety, grade and size was obtained, together with a record of all supplies purchased through the marketing agency. The accuracy of this study was greatly enhanced by the cooperation of the various marketing agencies in supplying this information. From the data obtained each grower's net income for the year and his cost of producing apples was calculated.

Essentially the same growers were revisited each year of the study to trace the fortunes of each orchard through a three year period. A small number of substitutions were necessary during the second

and third years due to deaths of operators or to changing ownership of some orchards studied.

An effort was made to obtain representative orchards. Approximately equal numbers of records were taken in each area of the main districts and failing orchards were included as well as those which were successful.

Table 26 of the appendix shows the size of sample studied in both producing areas.

FINANCIAL RETURNS OF THE WENATCHEE GROWERS STUDIED

In studying the financial condition of these orchards the farm enterprise as a whole was considered. While apple receipts constitute the major share of the income, receipts from pears, cherries or other sidelines were included. The measures used to compare incomes are explained in the immediately following paragraphs.

Farm Income. The amount remaining from the year's gross receipts after all current expenses, the estimated value of unpaid family labor (not including the labor of the operator), and depreciation on buildings and equipment have been subtracted.¹ The farm income is what is left to cover (1) wages for the operator's labor for the year, and (2) interest on the capital invested in the farm.

Labor Income. That part of the farm income remaining as a wage for the operator's labor (part 1 of farm income) after six per cent interest on the invested capital has been deducted. Six per cent is allowed as it is believed that few men could obtain a higher rate in a really safe investment of any other type. Six per cent is a prevailing rate in such securities as the stock of various public utilities.

Rate of Return on Investment. This is the actual rate of return to the capital invested in the farm enterprise. It is computed by subtracting the farmer's estimate of the value of his physical labor in farm work for the year, (disregarding any pay for supervision or managerial ability) from the farm income. The remainder is considered as interest earned by the invested capital (part 2 of farm income). When this amount is divided by the total investment in the farm and

¹If a livestock enterprise is carried at a loss for the year, the net decrease in livestock is also subtracted from the year's gross receipts. This factor has very little importance where orcharding is the main enterprise.

the result multiplied by 100 the actual rate per cent of interest earned is calculated.

Computing "Labor Income" and "Per Cent Return on Investment" are simply two ways of dividing the farm income. The man who considers his time the more important factor is most interested in figuring the labor income, while the man primarily interested in finding the most profitable place to use his capital prefers to compute the interest his money is earning from the orchard investment.

Since unpaid family labor and depreciation (which have been charged off as expense in figuring farm income) are not **cash** items of expense, the farmer often uses these amounts for other purposes, although a better policy unless hard pressed for cash, is to set aside such funds each year in a reserve from which to make replacements as needed.

"Maximum **Cash** Available for Family Living" therefore, often amounts to considerably more than the computed farm income and is found in the following way: Add together all **cash** receipts from crops, sale of livestock or livestock products and any other **cash** items of income which should be credited to the farm. From this total of gross **cash** receipts subtract the total of all **cash** expenses for operating the farm for the year. Purchases of livestock for cash and any payments of mortgage interest should be included. The remaining amount should represent the actual **cash** the farmer has left to use from one year's farming operations.

"Total Family Living" goes farther and includes the estimated value of the perquisites supplied by the farm, such as crop and livestock products used by the family and the rent value of the house they live in. The formula for finding total family living is as follows: To maximum cash available for family living, add all items of family use plus six per cent interest on the value of the dwelling, as house rent.

Table 3 shows conditions as found in the Wenatchee District on the orchards studied.

Table 3. Financial Returns of Orchards, Wenatchee District, Years 1926, 1927 and 1928 and Three-year Average

Year	Acres in bearing orchard	No. of Farms	Average acreage	Average investment per farm	Av. rate return on investment	Measures of profit			
						Farm income	Labor income	*M. C. for F. L.	Total F. L.†
1926	0-15 acres.....	64	8.69	\$20,138.49	+2.66%	\$ 455.84	\$ -752.47	\$ 774.95	\$1,117.95
	15.1-30 acres.....	17	22.88	36,051.63	-2.91%	-250.87	-2,413.97	27.06	383.41
	Average both groups.....	81	11.67	23,478.28	-2.74%	307.52	-1,101.18	617.98	963.79
1927	0-15 acres.....	62	8.72	19,631.62	11.85%	3,283.31	2,105.41	3,635.68	3,953.08
	15.1-30 acres.....	20	20.98	34,028.58	17.76%	6,811.88	4,770.17	7,063.51	7,371.21
	Average both groups.....	82	11.71	23,143.08	13.97%	4,143.93	2,755.35	4,471.73	4,786.77
1928	0-15 acres.....	63	8.68	19,413.39	3.49%	1,646.64	481.84	1,969.38	2,240.17
	15.1-30 acres.....	19	22.47	36,846.93	4.35%	2,377.60	166.79	2,804.95	3,071.90
	Average both groups.....	82	11.88	23,452.87	3.81%	1,816.01	408.84	2,162.99	2,432.89
Three year average	0-15 acres.....	63	8.70	19,730.51	4.09%	1,780.30	596.47	2,111.53	2,422.07
	15.1-30 acres.....	18.67	22.06	35,598.95	6.70%	3,163.34	1,027.41	3,482.58	3,791.22
	Average both groups.....	81.67	11.75	23,357.58	5.00%	2,096.43	694.97	2,424.91	2,735.02

*M. C. for F. L. means maximum cash available for family living.

†Total F. L. means maximum cash available for family living.

+A minus sign (-) denotes a negative amount or loss.

The farms have been divided for study into those having less than 15 and those having between 15 and 30 acres in bearing orchard. In 1926, the least profitable year of the study, the group having less than 15 acres in bearing orchard weathered through in much better condition than the group of larger farms. The average grower on the smaller orchard was able by extra effort on his own part and the members of his family to sidestep most of the cash expenditures for hired labor which were necessary on the larger tracts. With less actual **cash outlay** to grow the crop, a proportionately larger amount of available cash remained on the smaller orchards after expenses were taken out of the meager crop returns. In the 1927 and 1928 seasons, when better prices were received, the group of orchards between 15 and 30 acres in size made larger farm incomes and returned a higher rate of interest on the invested capital. The question of best size of orchard will be treated in more detail later in the bulletin.

The widespread losses experienced in 1926 were largely recouped in the exceptional profits of 1927 and the average farm studied in the Wenatchee District made a fair profit on his farm business in 1928.

The three year average farm income of \$2,096.43 realized on these 81 farms, paid an average of five per cent on the invested capital and allowed the grower an average of \$694.97 to pay for his own labor. Maximum cash available for family living averaged over \$2,400 and total family living averaged over \$2,700.

A 10 year average would probably show somewhat lower returns than are presented in Table 3, yet it is believed that average profits made by the Wenatchee fruit grower are as good or better than those realized in other types of farming with a similar amount of invested capital. In the irregularly alternating periods of good and poor years many growers believe that the poor year always come first. Thus the average grower was forced to use a large share of his 1927 profits to pay off debts incurred in producing the unprofitable crop of 1926. This condition causes many growers to depend on their marketing organizations to finance the production of each season's crop. The grower who is able to finance his own operations is producing at a big advantage when competing with growers who must be financed.

FINANCIAL CONDITIONS OF THE YAKIMA GROWERS STUDIED

Table 4 presents data on the financial returns from the 87 farms studied in the Yakima area over the three year period. Average returns for the three years are similar to those shown in Table 3 for the Wenatchee District. Average profits in the 1926 season were higher on these farms than on those studied in the Wenatchee Valley. The group of Yakima farms of 15 to 30 acres in size maintained their superiority in larger profits in 1926 as well as in 1927 and 1928. Both these differences from results obtained in the Wenatchee area are possibly explained by the greater diversification of the Yakima orchards. Many of these growers produced considerable quantities of pears, peaches, cherries, or apricots; while the average orchard in the Wenatchee area probably derives 95 per cent of its receipts from apples alone. In 1926, when apples were a "drug on the market," the Yakima grower still had receipts from soft fruit crops upon which to fall back. The future outlook for the soft fruit crops, as discussed in Bulletin 238 of this station, would indicate returns less promising than in the recent past. It is possible that the present advantage enjoyed in poor apple-years by the Yakima grower who raises soft fruits as a sideline, may be materially lessened in the next decade.

Table 4. Financial Returns of Orchards, Yakima District, Years 1926, 1927 and 1928 and Three-year Average.

Year	Acres in bearing orchard	No. of farms	Average acreage	Av. investment per farm	Av. rate of return on investment	Measures of profit		
						Farm income	Labor income	*M.C. for F.L.† Total F.L.‡
1926	0—15 acres.....	55	9.85	\$17,231.65	+1.12%	\$ 782.26	\$ -251.64	\$1,017.52
	15.1—30 acres.....	31	19.94	28,006.26	1.61%	1,391.30	-289.07	1,794.67
	Average both groups.....	86	13.49	21,115.52	.19%	1,001.80	-265.13	1,297.66
1927	0—15 acres.....	56	9.89	17,171.33	8.29%	2,387.23	1,347.95	2,716.27
	15.1—30 acres.....	32	19.69	28,220.39	12.37%	4,430.23	2,745.83	4,802.97
	Average both groups.....	88	13.46	21,189.17	10.27%	3,127.68	1,856.27	3,475.07
1928	0—15 acres.....	57	9.80	17,086.92	1.89%	1,238.75	213.53	1,538.49
	15.1—30 acres.....	30	20.57	31,601.57	4.35%	2,335.11	439.02	2,899.29
	Average both groups.....	87	13.51	22,091.98	3.11%	1,616.80	291.29	2,007.73
Three year average	0—15 acres.....	56	9.85	17,162.44	3.04%	1,469.13	439.38	1,760.53
	15.1—30 acres.....	31	20.06	29,239.72	6.14%	2,744.50	990.06	3,186.11
	Average both groups.....	87	13.49	21,465.84	4.54%	1,923.57	635.60	2,268.50

*M. C. for F. L. means maximum cash available for family living.

†Total F. L. means total family living.

‡A minus sign (-) denotes a negative amount or loss.

**A STUDY OF THE TEN MOST PROFITABLE AND THE TEN
LEAST PROFITABLE ORCHARDS IN THE
WENATCHEE DISTRICT OVER THE
THREE YEAR PERIOD, 1926-'28**

The 10 farms having the highest average labor incomes per acre of bearing orchard were selected as the most consistently profitable over the three year period, and the 10 having the lowest average labor incomes per acre of bearing orchard were considered the least profitable. Table 5 presents some factors which were instrumental in the success or failure of these two groups.

The high total investment of the 10 least profitable orchards is in itself no plausible reason for their failure since these farms averaged over five acres more land in bearing orchard than the 10 most profitable farms. The average value, however, of an acre of bearing apples on the least profitable farms was \$174 per acre higher than the average per acre value on the most profitable group. In view of yields obtained and varieties grown it is apparent that these poorer orchards were overvalued.

The average per acre yield obtained on the 10 most profitable orchards was consistently high in each year. In 1927 the average per acre yield on the least profitable group dropped considerably below the yields obtained in 1926 and 1928. This spasmodic swing between high and low yields is characteristic of poorly managed orchards. One of the chief causes for this yearly variation, is the failure of the grower to thin heavily enough when exceptionally favorable conditions result in an abnormally heavy set of fruit. Pruning methods are also a factor in regulating size of yield obtained. The 10 most profitable orchards averaged 238 more boxes per acre than the least profitable group. Yield is one of the most vital factors in the success or failure of any orchard.

Table 5 shows the 10 least profitable orchards to have a higher per cent of their average yield composed of Winesaps than the group of most profitable farms. Almost half the average yield on the profitable farms was made up of the Delicious variety while but slightly over 10 per cent of the yield on the poor farms was Delicious. Over three-fourths the average crop on the best farms was Winesap and Delicious while less than half the crop on the poor farms was composed of these

Table 5. A study of the Ten Most Profitable and the Ten Least Profitable Orchards Surveyed in the Wenatchee District Over the Three-Year Period of 1926, 1927 and 1928

	*10 most profitable	*10 least profitable
1. Average total investment per farm	\$19,391.88	\$30,337.30
2. Average per acre value of land in full bearing apples.....	1,288.73	1,463.04
3. Average acres of full bearing apples per farm.....	7.66 acres	13.01 acres
4. Yield study:		
Average yield per acre 1926.....	638 boxes	418 boxes
Average yield per acre 1927.....	642 boxes	346 boxes
Average yield per acre 1928.....	741 boxes	542 boxes
Three-year average per acre yield	673 boxes	435 boxes
5. Variety study:		
Per cent of yield, Winsaps.....	30.97%	36.74%
Per cent of yield, Delicious.....	46.73%	10.43%
Per cent, Winesaps and Delicious	77.70%	47.17%
6. Quality study:		
Average per cent Extra Fancy.....	59.64%	42.20%
Average per cent Fancy.....	28.94%	39.56%
Average per cent Extra Fancy and Fancy	88.58%	81.76%
Average per cent "C" grade.....	7.77%	12.40%
Average per cent other grades.....	3.65%	5.84%
7. Cost and profit study:	Per acre	Per box
Average gross returns for apples	\$1,043.74	\$1.55
Average cost of production.....	723.97	1.07
Average profit	319.77	.48
Average loss		-94.79
		\$11.17
		605.34
		1.40
		-.23

*Ten highest and ten lowest labor incomes per acre of bearing orchard.

varieties. The high percentage of Delicious and Winesap on the 10 most profitable farms has undoubtedly made a large contribution to their success.

A comparison of the quality of fruit produced by these two groups shows 17.44 per cent more Extra Fancy apples in the group of most profitable farms. With less Extra Fancy, the group of least profitable farms produced a larger per cent of both Fancy and "C" grade apples. As long as premiums are paid for certain varieties of apples and for high quality within the variety, these factors will have much to do with the success or failure of any orchard.

The three year average gross return per acre on the profitable group is over twice that on the unprofitable group and per box returns are 38 cents higher. Per box variations are influenced chiefly by varieties grown, size, and quality of the fruit.

The wide variation in per acre returns is due to a combination of varieties, quality, size, and yields.

The cost of production was 33 cents greater per box on the least profitable group. The low per acre yield of this group accounts for a large part of the difference in costs. The average profits as shown are clear after the grower's own labor and interest on all items of his orchard investment have been deducted.

THE COST OF PRODUCING APPLES

Explanation of Terms and Methods in Figuring the Cost of Producing Apples

Since essentially the same method of calculation was used in computing the cost of producing apples in the Wenatchee and Yakima Districts, an explanation of terms and methods of procedure will be detailed which will be applicable to both areas. Table 6 is the basis of this discussion.

Land investment is the average of estimates by the growers as to the value of the land and full bearing trees with no other improvements attached.

Equipment investment covers all items from pruning tools to tractors. Each grower was questioned as to the average life of the various implements under his conditions and actual rates of depreciation were determined. That portion of the expense for farm power, (gas, oil,

farm car, and electricity) which is rightly chargeable to the apple crop, has been included under equipment costs. While this expense is not a true item of "Overhead Cost," it was included here as being more nearly related to equipment charges than to other items of cost.

Building investment covers only those buildings concerned with apple production, the dwelling and special buildings for poultry or dairy enterprises, having been excluded. That part of land tax and fire insurance more properly borne by such buildings has been excluded for the same reason.

Investments in irrigation system range from open ditches and wooden flumes to concrete and metal pipelines.

The average per acre investment in equipment, buildings and irrigation system includes outlays varying from those too small to permit efficient performance of labor to those so elaborate as to be a serious handicap to the success of the farm.

Land tax on the individual ranch is governed by such factors as amount of improved and unimproved land, character of water right, type of soil, lay of land, kinds and varieties of fruit grown, age of trees, number of feet of lift if water must be pumped up to the land and the amount of improvements on the tract.

The cost of water varies in different localities, the tax being determined largely by whether the system is owned by some development company, by few or many farmers, or is a government project. Water charges are made up of levys for "maintenance" and "construction." Under systems making extensive improvements, the "construction" charge may be quite heavy. While construction expense is in the strictest sense an improvement, annual payments are made over a sufficient period of time to justify classing it as an item of current expense and it is added to the "maintenance" charge as part of the yearly water tax in the cost figures.

Crop insurance is carried by relatively few growers except those located in areas subject to damage by hail.

Liability insurance covering accidents to workers while employed in orchard operations is still in its infancy, but more growers are adopting this form of protection each year.

Cultural material costs vary widely from farm to farm. In some areas seven or eight cover sprays must be applied while in other

districts less than 20 miles distant, but at much higher elevations, less than half that number are used. In figuring costs of fertilizer and dormant spray in areas where applications are made only once in two years, one-half the cost has been taken as the yearly charge.

Each grower should check his costs for the various operations under "Cultural Labor" against the average figure. Variations from the average will occur on each orchard, but where the difference is marked there should be some plausible reason for it. Such comparisons should reveal the strong and the weak points in the grower's production program. All labor charges cover the entire cost of the job regardless of whether the labor was hired or performed by the grower and his family.

Interest at six per cent for six months is charged on the operating expense in growing the crop up to harvest time.

When the apple acreage contained a few trees of some other fruit, returns from this fruit were subtracted from the cost of production of apples rather than to attempt the allocation of a small portion of the cost to these trees. This calculation is shown under "Miscellaneous Fruit Returns, Credited."

Total cost, both including and excluding six per cent interest on the investment in land, has been figured up to the time of harvesting the fruit. The expenses incurred in harvesting the crop including packing and delivery of the packed fruit to the warehouse are then added, together with interest on the operating expense during harvest, to arrive at the total cost of the packed fruit delivered at the warehouse.

While the harvesting season including packing, seldom exceeds two months on the farm of average size, six per cent interest for six months was used as the rate on operating expenses during harvest. Since the majority of growers borrow to meet harvest expenses and the financing period often extends till final returns for the fruit are received some six months later, it was believed that this charge was justified.

The Cost of Producing Apples on 81 Orchards in the Wenatchee District

The 81 farms which form the basis of this study were scattered throughout the valley of the Wenatchee river from Pehastin to Wenatche and along the Columbia river in the Malaga, Rock Island, East Wenatchee, Entait and Orondo areas.

Table 6 presents the three year (1926-'28) average cost of producing apples on these orchards. For details of the average costs for each year of the study see Table 27 of the appendix.

Yearly variations in yield on these 81 farms followed closely the variation in yield for the Wenatchee District as a whole. Total carlot shipments from the Wenatchee District for the 1927 crop were 90.40 per cent of the total 1926 crop shipments and 1928 crop shipments were 125.71 per cent of the 1926 shipments. The average yield in 1927 on the 81 farms studied was 93.16 per cent of the average yield for 1926 while the 1928 yield was 129.40 per cent of the 1926 yield.

The average valuation of \$1,263.35 per acre on apple land produces a heavy charge of \$75.80 per acre as interest on the investment. This adds 14.2 cents per box to the cost of production when the average yield of 535.6 boxes per acre is realized.

Equipment charges are an important item of cost. Many growers in the Wenatchee District were formerly equipped to do ranch packing. This meant considerable outlay for a suitable building, grader, sizer, conveyors, trucks, presses, etc. With the advent of the spray residue problem in 1926, growers were required to remove to a certain tolerance the deposit of lead arsenate left on the apple after spraying. Many growers purchased wiping machines in 1926 only to find them ineffective and in most cases a complete loss. In 1927 washing machines replaced the wipers but the investment was so large that only the larger growers could afford to install them and most of the smaller growers were forced into central packing. This ranch packing equipment, in most cases now idle and useless, has added materially to the costs borne by the grower in recent years.

The average land tax in the Wenatchee area is high. Much of Chelan county is too rugged to farm and the farming area upon which the county's taxes fall is much less in proportion than the farm area available for taxation in Yakima county. The upkeep of numerous roads and bridges in the cultivated foothill canyons is another item of expense.

Those costs that do not normally vary with yield are starred in Table 6. Such costs are termed "fixed costs" for the purpose of this study and will be discussed later.

Cultural labor costs are slightly higher per acre than in the Yakima

Table 6. Cost of Producing Apples, Wenatchee District, Three-Year Average, 1926, 1927 and 1928
(For details of cost for each year see appendix, table 27)

	Average 1926-'28	
Average number of orchards.....	81 orchards	
Average acres bearing apples per orchard.....	12.48 acres	
Average yield per acre in packed boxes.....	535.6 boxes	
Average investment per acre in:		
Land	\$1,263.35	
Equipment	141.87	
Buildings	123.87	
Irrigation System	36.96	
	Average cost 1926-28	
	Per acre	Per box
Overhead costs		
Land:		
*6% interest on investment.....	\$ 75.80	\$.142
Equipment:		
*6% interest on investment	8.51	
*Depreciation	28.22	
Repairs	7.90	
Power (gas, oil, farm car, electricity).....	12.85	
Total equipment costs	57.48	.107
Buildings:		
*6% interest on investment.....	7.45	
*Depreciation	6.56	
Repairs .....	.46	
*Insurance .....	.86	
Total building costs	15.33	.029
Irrigation system:		
*6% interest on investment.....	2.22	
*Depreciation	4.29	
Repairs .....	.77	
Total irrigation system costs.....	7.28	.013
Miscellaneous overhead charges:		
*Land tax	19.58	
*Water tax	13.16	
Crop insurance	1.19	
Liability insurance .....	.32	
Miscellaneous .....	.05	
Total miscellaneous overhead costs.....	34.30	.064
Total overhead costs	\$190.19	\$.355

*Costs that do not normally vary with yield.

Table 6. Cost of Producing Apples, Wenatchee District (Continued)

Average cost 1926-28		
	Per acre	Per box
Cultural material costs:		
*Dormant sprays	\$ 7.09	
*Cover sprays	14.81	
*Fertilizer and manure	8.78	
Miscellaneous .....	.95	
Total cultural material costs	\$ 31.63	\$.059
Cultural labor costs:		
*Pruning	\$ 21.55	
*Brush disposal	4.56	
*Cultivating (disc, harrow or plow)	2.57	
*Ditching out	1.41	
*Irrigating	17.58	
*Dormant spray labor	2.47	
*Cover spray labor	11.15	
*Cutting sprouts	1.89	
Thinning	31.36	
Propping	3.92	
Cleaning up orchard	1.80	
*Applying fertilizer or manure	1.21	
Hoeing around trees .....	.93	
Miscellaneous labor	2.48	
Total cultural labor costs	\$104.88	\$.196
Interest on operating expense to harvest.....	\$ 5.81	\$.011
Miscellaneous fruit returns (credited)	\$ 1.08	\$.002
Total cost ready to harvest excluding interest on land	\$255.63	\$.477
Total cost ready to harvest including interest on land	331.43	.619

*Costs that do not normally vary with yield.

Table 6. Cost of Producing Apples, Wenatchee District (Continued)

	Average cost 1926-28	
	Per acre	Per box
Harvesting costs:		
Hauling shook		\$.004
Picking .....		.083
Hauling in and out of orchard .....		.021
Hauling to warehouse .....		.019
Supervising harvest labor .....		.011
Packing (labor and material) .....		.397
Miscellaneous harvest labor .....		.001
Total harvesting costs	\$286.89	\$.536
Interest on operating expense during harvest...	\$ 8.61	\$.016
Total cost delivered at warehouse excluding interest on land	\$551.13	\$1.029
Total cost delivered at warehouse including interest on land	626.93	1.171
Total receipts	\$691.50	\$1.291
Net profits	64.57	.120
Total cash outlay ¹	\$479.47	\$.895
Total depreciation charge	39.06	.073
Total interest charge	108.40	.203

¹Includes the labor of the operator, his family, and his teams as cash outlay.

District. This is because the average Wenatchee grower is caring for a slightly larger crop and because wages paid hired labor are somewhat higher in Wenatchee. The average cost of a man hour in the Wenatchee area was 40 cents compared to 38 cents in Yakima, while the average horse hour in Wenatchee cost 18 cents compared to 14 cents in the Yakima District.

With average receipts of \$1.291 per box and an average cost of \$1.171 these 81 Wenatchee growers made a profit over the three year period of 12 cents per box or \$64.57 per acre.

Depreciation on Plantings an Added Cost

All legitimate charges have been included except depreciation on the orchard planting. The life of apple trees has been discussed on page 10. Estimates from 73 Wenatchee growers placed the average value of an acre of raw land suitable for orchard at \$309.08 including the water right. If the average full bearing acre is worth \$1,263.35 and the same acre without the trees is worth \$309.08, the difference of \$954.27 is the

value of the trees which is terminated when their productive life is over. Assuming a profitable life of 35 years for the planting and 10 years in which the trees are increasing in value as they come to full bearing condition, 25 full bearing years remain to stand the total depreciation charge of \$954.27.¹ This would add \$38.17 per acre or 7.1 cents per box to the average yearly cost of production when assuming the average yield of 535.6 boxes.

Number of Growers Producing at Certain Costs, Wenatchee District

Table 7 shows the number of growers producing at certain specified costs in each year of the study. The dispersion for each year is of interest when compared to the average yield obtained in that year.

In 1927 the lowest yields were experienced on the average, 1926 ranked next highest and 1928 was the year of highest yields. Correspondingly, only six orchards produced at costs below \$1.00 per box in 1927, eight produced below \$1.00 in 1926 and 15 in 1928. On the other extreme, 20 orchards produced at costs of \$1.50 or above in 1927, 14 in 1926 and only four in 1928. In high producing years the influence of yield tends to outweigh other factors which normally have con-

Wenatchee District, 1926, 1927 and 1928, and Three-Year Average
siderable effect on cost with the result that low costs per box are experienced. The three year average indicates the bulk of growers producing at costs ranging between \$1.00 and \$1.40 per box.

Table 7. Number of Farms Producing Apples at Specified Costs,

Range in cost of production per box	Number of farms producing at each cost			
	1926	1927	1928	3-year av.
\$0.80—.89.....	1	....	4	1.7
.90—.99.....	7	6	11	8.0
1.00—1.09.....	15	5	26	15.3
1.10—1.19.....	14	18	18	16.7
1.20—1.29.....	12	14	9	11.7
1.30—1.39.....	14	11	7	10.7
1.40—1.49.....	3	8	2	4.3
1.50—1.59.....	6	10	....	5.3
1.60—1.69.....	1	2	1	1.3
1.70—1.79.....	2	3	....	1.7
1.80 and over.....	5	5	3	4.3

¹Full bearing condition as used here, is not maximum production but the age at which apple trees normally begin to produce crops of about average size.

Three Year Average Rate of Return on Investment, Wenatchee District

The three year average cost of producing apples on 81 farms in the Wenatchee District was \$626.93 per acre. Deducting from this amount the interest charges on the investments in land, equipment, buildings and irrigation system the cost without interest on permanent investments is \$532.95 per acre. With a three year average return of \$691.50 per acre and a cost **without interest** of \$532.95, an average profit of \$158.55 per acre is realized. With a three year average investment of \$1,566.05 per acre the \$158.55 profit represents an average return of 10.12 per cent on the capital invested in the orchard enterprise. This calculation assumes all the profit to be a return on investment. While the physical labor of the grower has been included in the cost figures, no allowance has been made for a return for his management. If the grower chooses to place a value on this item, only a portion of the per acre profit would remain as a return to the capital invested, resulting in a lower rate of return.

Relative Influence of Cost and Receipts on Profits, Wenatchee District

Figure 4 indicates the yearly variations in costs and returns on the 81 farms studied in the Wenatchee District. Measuring the variations from the 1926 year as 100 per cent, the 1927 costs were 5.97 per cent above and the 1928 costs 8.33 per cent below the 1926 cost of production. The widest fluctuation in cost was 14.30 per cent of the 1926 cost.

The 1927 returns were 175.94 per cent and 1928 returns 113.76 per cent of the 1926 returns taken as 100 per cent. The widest fluctuation was 75.94 per cent of the 1926 returns. Fluctuations in returns during this three year period were over five times more violent than fluctuations in production costs. Returns received by the grower are influenced by crop conditions in apple producing regions over the entire United States and abroad, and by other factors beyond his control. His efforts are used most efficiently in trying to reduce his own cost of production, thus widening the margin of profit received. The discovery of a new method of performing a certain operation which results in cutting the cost of production five cents per box is an advantage which may

be capitalized on every year thereafter. If the grower obtained a five cent increase in price due to his own efforts, it would be only the result of a temporary condition which could not be repeated year after year. It seems clear that the grower's efforts will be more effective when applied to reduction of cost than when expended in a vain endeavor to affect prices received.

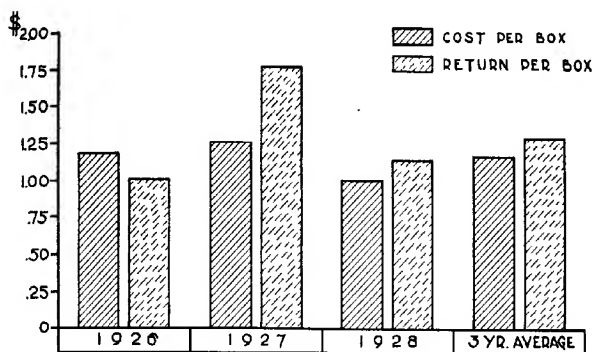


Fig. 4. Costs and receipts per box by years, Wenatchee District. The distance from the top of the cost bar to the top of the bar indicating receipts shows the margin of profit realized in each year.

Cost of Production of Apples on Manager Operated Orchards in the Wenatchee District

Table 8 presents a summary of average production costs on 17 orchards operated by hired ranch managers during the three years of the study. These orchards were studied separately because of their larger average size and their difference in organization from the average owner operated orchard. For yearly variations in cost on these orchards see Table 28 of the appendix.

These orchards averaged 79.24 acres in full bearing apples as compared to 12.48 acres on the average owner operated orchard. Yields averaged 384.6 boxes as compared to 535.6 boxes per acre on the 81 Wenatchee orchards operated by owners. For maximum yields in apple production individual attention must be given to the special needs of

Table 8. Cost of Producing Apples on 17 Orchards Operated by Hired Ranch Managers, Wenatchee District. Three-Year Average, 1926, 1927 and 1928

(For costs for separate years see Table 28 of appendix)

	Average 1926-1928	
Number of orchards.....	16.67 orchards	
Average acres bearing apples per orchard.....	79.24 acres	
Average yield in packed boxes per acre.....	384.61 boxes	
Average per acre investment in land.....	\$806.90	
	Average costs 1926-1928	
	Per acre	Per box
Total cost to harvest excluding interest on land	\$257.65	\$0.670
Total cost to harvest including interest on land	306.07	.795
Total cost delivered at warehouse excluding interest on land	\$504.09	\$1.311
Total cost delivered at warehouse, including interest on land	552.51	1.436
Total receipts	\$468.84	\$1.219
Net profit		
Net loss	83.67	.217
Total cash outlay	\$447.58	\$1.164
Total depreciation charges	26.70	.069
Total interest charges	78.23	.203

each tree. On the larger orchards with nearly all labor hired, it is unusual to farm as intensively as this. This is one reason why yields tend to decrease as size of orchard increases. Nearly all records for high production are made on the smaller tracts.

The average valuation placed on an acre in full bearing apples is over \$400.00 less than that on the owner operated orchards in the Wenatchee District. Varieties grown, yields obtained, age and condition of trees, uniformity of soil, and similar factors, tend to fluctuate more widely on the larger acreages and result in a lower per acre valuation.

Over the three year period these orchards produced at a cost of \$1.436 per box as compared to \$1.171 per box on the owner operated

orchards. When all labor must be hired every year the large farms operate at a distinct disadvantage in poor years. Receipts averaged \$1.219 per box as compared to \$1.291 on the owner operated tracts, indicating a slightly less desirable selection of varieties or poorer average quality of crop on the manager operated orchards. The size of these tracts has probably been a factor in the facility with which they were able to convert their plantings into the more popular varieties. While several of these orchards made profits in 1927 and 1928 the group as a whole produced at a loss of 21.7 cents per box over the period of the study. It would appear that large scale production should be attempted only under the most favorable conditions and if possible, under the direct supervision of the owner.

THE COST OF PRODUCING APPLES ON 87 ORCHARDS IN THE YAKIMA DISTRICT

The 87 orchards averaged to obtain the cost figures presented in Tables 9 and 10 were selected in about equal numbers from the main apple producing areas in the Yakima District north of Union Gap. Besides the area within a five mile radius of the city of Yakima, the following districts were studied: Ahtanum, Wiley City, Wide Hollow, Upper and Lower Naches; Naches Heights, Cowiche, Tieton and Selah.

In the Yakima area the use of filler trees is widespread. When the apple trees are set out they are interplanted with some soft fruit crop, usually pears, which come into bearing several years earlier than the apples. Returns from soft fruit thus help finance the apple planting into production. As soon as crowding occurs and the two fruits begin to compete for plant food and soil moisture, the filler trees are in theory, promptly removed. Approximately half the orchards on which cost data were obtained were interplanted with filler trees. Filler and non-filler orchards have been handled separately since their problems are somewhat different and since the filler practice necessitated a different procedure in figuring apple costs.

The method of cost calculation on the non-filler orchards in the Yakima District is identical with that used in computing costs in the Wenatchee areas as discussed on page 24.

Where filler trees were used, it was believed they should share in the overhead expense since they return a substantial part of the in-

Table 9. Cost of Producing Apples, Yakima District, Orchards Set Only to Apples, Three-Year average 1926, 1927 and 1928
(For details of costs for each year see appendix, table 29)

	Average 1926-28	
Average number of orchards.....	43% orchards	
Average acres bearing apples per orchard.....	14.12 acres	
Average yield per acre in packed boxes.....	484.45 boxes	
Average investment per acre in:		
Land.....	\$976.57	
Equipment.....	84.32	
Buildings.....	101.30	
Irrigation system.....	29.77	
	Average cost 1926-28	
	Per acre	Per box
Overhead costs		
Land:		
*6% interest on investment	\$ 58.59	\$.121
Equipment:		
*6% interest on investment	\$ 5.06	
*Depreciation	15.53	
Repairs	7.37	
Power (gas, oil, farm car, electricity).....	11.92	
Total equipment costs.....	\$ 39.88	\$.082
Buildings:		
*6% interest on investment	\$ 6.08	
*Depreciation	5.12	
Repairs .....	.51	
*Insurance	1.09	
Total building costs	\$ 12.80	\$.027
Irrigation system:		
*6% interest on investment	\$ 1.79	
*Depreciation	2.47	
Repairs .....	.24	
Total irrigation system costs	\$ 4.50	\$.009
Miscellaneous overhead charges:		
*Land tax	\$ 10.40	
*Water tax	9.23	
Crop insurance	1.34	
Liability insurance	1.16	
Total miscellaneous overhead costs.....	\$ 22.13	\$.046
Total overhead costs	\$137.90	\$.285

*Costs that do not normally vary with yield.

Table 9. Cost of Producing Apples, Yakima District (Continued)

	Average cost 1926-28	
	Per acre	Per box
Cultural labor costs		
*Dormant sprays	\$ 6.02	
*Cover sprays	12.14	
*Fertilizer and manure	5.28	
Miscellaneous .....	.99	
Total cultural material	\$ 24.43	\$.050
Cultural labor costs		
*Pruning	\$ 13.87	
*Brush disposal	4.22	
*Cultivating (disc, harrow or plow)	2.63	
*Ditching out	1.32	
*Irrigating	12.04	
*Dormant spray labor	2.49	
*Cover spray labor	10.84	
*Cutting sprouts	1.33	
Thinning	21.78	
Propping	1.96	
Cleaning up orchard .....	.16	
*Applying fertilizer or manure	1.38	
*Hoeing around trees	1.03	
Miscellaneous labor	1.88	
Total cultural labor costs	\$ 76.93	\$.159
Interest on operating expense to harvest.....	\$ 4.34	\$.009
Miscellaneous fruit returns (credited).....	\$.46	\$.001
Total cost ready to harvest excluding interest on land	\$184.55	\$.381
Total cost ready to harvest including interest on land	243.14	\$.502

*Costs that do not normally vary with yield.

Table 9. Cost of Producing Apples, Yakima District (Continued)

	Average cost 1926-28	
	Per acre	Per box
Harvesting costs		
Hauling shook		\$.004
Picking .....		.081
Hauling in and out of orchard .....		.021
Hauling to warehouse .....		.021
Supervising harvest labor .....		.005
Packing (labor and material) .....		.397
Miscellaneous harvest labor .....		.001
Total harvesting costs	\$256.69	\$.530
Interest on operating expense during harvest..	7.70	\$.016
Total cost delivered at warehouse excluding interest on land	\$448.94	\$.927
Total cost delivered at warehouse including interest on land	507.53	1.048
Total receipts	\$570.98	\$1.179
Net profit	63.45	.131
Total cash outlay ¹	\$400.85	\$.827
Total depreciation charge	23.12	.048
Total interest charge	83.56	.173

¹Includes the labor of the operator, his family and his team as cash outlay.

Table 10. Cost of Producing Apples, Yakima District, Orchards Containing Filler Trees, Three-Year Average, 1926, 1927 and 1928
(For details of yearly costs see appendix table 30)

Average cost 1926-28		
Average number of orchards.....	43%	orchards
Average acres bearing apples per orchard.....	13.06	acres
Average yield per acre in packed boxes.....	459.90	boxes
Average investment per acre in:		
Land.....	\$1,011.35	
Equipment.....	76.19	
Buildings.....	68.62	
Irrigation system.....	23.82	
Average 1926-28		
	Per acre	Per box
Overhead costs		
Land:		
*6% interest on investment	\$ 60.68	\$.132
Equipment:		
*6% interest on investment	\$ 4.57	
*Depreciation	15.48	
Repairs	4.85	
Power (gas, oil, farm car, electricity).....	9.88	
Total equipment costs	\$ 34.78	\$.076
Buildings:		
*6% interest on investment	\$ 4.12	
*Depreciation	3.59	
Repairs .....	.23	
*Insurance .....	.66	
Total building costs	\$ 8.60	\$.019
Irrigation system:		
*6% interest on investment	\$ 1.43	
*Depreciation	1.87	
Repairs .....	.16	
Total irrigation system costs	\$ 3.46	\$.007
Miscellaneous overhead charges:		
*Land tax	\$ 10.01	
*Water tax	10.65	
Crop insurance .....	.56	
Liability insurance	1.04	
Total miscellaneous overhead costs.....	\$ 22.26	\$.048
Total overhead costs	\$129.78	\$.282

*Costs that do not normally vary with yield.

Table 10. Cost of Producing Apples, Yakima District—(Continued)

	Average cost 1926-28	
	Per acre	Per box
Cultural material costs:		
*Dormant spray	\$ 5.15	
*Cover spray	9.85	
*Fertilizer and manure	4.62	
Miscellaneous .....	.26	
Total cultural material	\$ 19.88	\$.043
Cultural labor costs:		
*Pruning	\$ 12.77	
*Brush disposal	4.70	
*Cultivating (disk, harrow or plow).....	3.61	
*Ditching out	1.63	
*Irrigating	13.90	
*Dormant spray labor	2.33	
*Cover spray labor	10.81	
*Cutting sprouts .....	.95	
Thinning	21.41	
Propping	1.68	
Cleaning up orchard .....	.16	
*Applying fertilizer or manure	1.95	
*Hoeing around trees .....	.65	
Miscellaneous labor .....	.66	
Total cultural labor costs	\$ 77.21	\$.168
Interest on operating expense to harvest.....	\$ 4.05	\$.009
Total cost ready to harvest excluding interest on land	\$170.24	\$.370
Total cost ready to harvest including interest on land	\$230.92	\$.502

*Costs that do not normally vary with yield.

Table 10. Cost of Producing Apples, Yakima District—(Continued)

	Average cost 1926-28	
	Per acre	Per box
Harvesting costs:		
Hauling shook		\$.005
Picking .....		.081
Hauling in and out of orchard .....		.023
Hauling to warehouse .....		.023
Superivising harvest labor .....		.004
Packing (labor and material) .....		.408
Total harvesting costs	\$249.95	\$.544
Interest on operating expenses during harvest..	\$ 7.50	\$.016
Total cost delivered at warehouse excluding interest on land	\$427.69	\$.930
Total cost delivered at warehouse including interest on land	488.37	1.062
Total receipts	\$555.00	\$1.207
Net profit	66.63	.145
Total cash outlay ¹	\$385.08	\$.837
Total depreciation charge	20.94	.046
Total interest charge	82.35	.179

¹Includes the labor of the operator, his family and his teams as cash outlay.

come on the acre. Division of all overhead costs have been made on the basis of the number of permanent and filler trees. On an acre having 50 permanent apple trees and 25 pear fillers, apples have been given 50-75 or two-thirds of the various yearly overhead charges and the production of these trees is rated as on two-thirds of an acre. Costs other than overhead, were estimated on the permanent trees alone by each grower interviewed. In figuring per acre costs on the filler ranches the reduced acreage has been used; thus in the preceding probm, 50-75 of the acre would be assumed to belong to apples, the other third being assigned to pears. The reduced acreage thus approximates an area set only to apples, exclusive of the area occupied by filler trees. In all other respects calculation methods are identical with those previously explained. The three year average costs for non-filler and filler orchards in the Yakima District are presented in Tables

9 and 10. For details of yearly costs see Tables 29 and 30 of the appendix.

Yearly variations in yield on these orchards followed closely variations in total shipments from the entire Yakima District. Using total shipments from the Yakima Valley in 1926 as 100 per cent; 1927 total shipments were 79.94 per cent and 1928 shipments 110.64 per cent of the 1926 shipments. On the non-filler orchards studied, 1927 yields were 76.64 per cent and 1928 yields 106.13 per cent of the 1926 yield. On the orchards containing fillers, 1927 yields were 89.18 per cent and 1928 yields 114.45 per cent of the 1926 yields.

Costs on the two groups are substantially the same, the slight difference in favor of the non-filled orchards being caused by the lower average yield on the group having filler trees. By dividing costs rightly chargeable to apples in the filler group by the reduced acreage which produces the apples, we in effect, eliminate the filler from the study and the resultant per acre charges are comparable to the same charges on areas set only to apples. Figures on the per box basis, however, are still influenced by the fillers, since the lower average yield of apples probably results from leaving filler trees too long in the apple planting.

Depreciation on Plantings an Added Cost

In the Yakima District the average value of full bearing orchard land was \$993.28 on the farms studied. (All figures in the discussion of depreciation are based on filler and non-filler farms averaged together.) The same land after removal of trees was estimated to be worth \$278.15 per acre. The difference of \$715.13 is the total value of the trees on the average acre. Allowing the 25-year period from full bearing at 10 years to the end of profitable life at 35 years to meet this total depreciation charge, an expense of \$28.61 per acre may be legitimately added to the cost of production. On the three-year average yield of 472.66 boxes per acre, depreciation on the orchard planting would add six cents (\$.0605) per box to the cost of production. In actual practice the orchard is not allowed to revert to an undeveloped state, but replacements are made each year as needed. Depreciation cost, however, would remain substantially the same whether we figure the work done piecemeal or all at one time.

Number of Growers Producing at Certain Costs, Yakima District

Tables 11 and 12 show the number of growers producing at certain costs for each year of the study in the Yakima District. It is interesting to note the large number of growers producing at comparatively low costs in 1926 and 1928, the years of high yields for the average grower. These tables show how representative the average cost is of the entire group for each year of the study. Over the three-year period the filler and non-filler groups averaged exactly the same number of orchards (43.67). During these years 25.19 per cent of the orchards in the non-filler group produced at costs over \$1.20 per box. For the

Table 11. Number of Farms Producing Apples at Specified Costs, on Orchards Set Only to Apples, Yakima District, 1926, 1927 and 1928 and Three-Year Average

Range in cost of production per box	Number of farms producing at each cost:			
	1926	1927	1928	3-yr. av.
\$0.70—.79.....	1	....	....	.3
.80—.89.....	7	1	8	5.3
.90—.99.....	19	7	12	12.7
1.00—1.09.....	9	9	6	8.0
1.10—1.19.....	4	11	4	6.3
1.20—1.29.....	3	6	3	4.0
1.30—1.39.....	3	2	2	2.3
1.40—1.49.....	1	1	1	1.0
1.50—1.59.....	2	6	....	2.7
1.60—1.69.....	....	....	....	....
1.70—1.79.....	....	....	....	....
1.80 and over.....	....	2	1	1.0

Table 12. Number of Farms Producing Apples at Specified Costs, on Orchards Containing Filler Trees, Yakima District, 1926, 1927 and 1928 and Three-Year Average

Range in cost of production per box	Number of farms producing at each cost:			
	1926	1927	1928	3-yr. av.
\$0.70—.79.....	1	....	1	.7
.80—.89.....	4	1	11	5.3
.90—.99.....	9	8	9	8.7
1.00—1.09.....	8	5	7	6.7
1.10—1.19.....	6	9	5	6.7
1.20—1.29.....	4	7	3	4.7
1.30—1.39.....	....	7	2	3.0
1.40—1.49.....	5	3	2	3.3
1.50—1.59.....	1	1	2	1.3
1.60—1.69.....	1	2	2	1.7
1.70—1.79.....	....	1	....	.3
1.80 and over.....	2	2	....	1.3

same period 35.72 per cent of the filler orchards produced at costs exceeding \$1.20 per box. This would seem to indicate a relative advantage with those orchards set only to apples.

Three-Year Average Rate of Return on Investment, Yakima District

The three-year average total investment on the non-filler group was \$1,191.96 per acre. The average cost of production after deducting all interest charges on permanent investments was \$436.01 per acre. Subtracting this cost from the three-year average return of \$570.98 per acre, \$134.97 remains as interest on the invested capital. This amount is an 11.32 per cent interest return on the average total investment.

On the filler group the three-year average total investment was \$1,179.98 per acre, cost less interest charges, \$417.57 per acre and returns \$55 per acre. The \$137.43 returned above cost, represents an 11.65 per cent interest return on the investment. These calculations assume all profit to be a return to capital. Should the grower make a charge for his management the rate of return to capital would be lowered. The grower's physical labor has already been figured in as part of the cost.

RELATIVE INFLUENCE OF COSTS AND RECEIPTS ON PROFITS, YAKIMA DISTRICT

The cost of production on the non-filler ranches in 1927 averaged 114.38 per cent and in 1928, 99.40 per cent of their cost of production in 1926. Returns on this group based on 1926 returns as 100 per cent were 158.75 per cent in 1927 and 107.08 per cent in 1928.

On the filler orchards costs varied as follows: 1926—100 per cent, 1927—105.22 per cent, and 1928—93.38 per cent. Returns for the filler group were: 1926—100 per cent, 1927—161.11 per cent, and 1928—109.21 per cent. The widest fluctuation in costs was 14.98 per cent in the non-filler group. The widest variation in returns was 61.11 per cent in the filler group. Fluctuations in returns averaged over four times as great as the widest fluctuations in cost.

While returns show by far the widest variation, the efforts of the average grower will be more effective when applied to cutting costs on the farm than when expended in efforts to obtain better prices.

A STUDY OF THE WISDOM OF THE PRESENT FILLER PRACTICE

It is doubtful if the grower gains as much from the use of filler trees as is commonly believed. Table 13 is a comparison of results obtained in the Yakima area on 37 orchards without filler trees and 43 orchards containing fillers in the 1928 crop year. It should be clearly understood that the reduced acreage has been used on the filler orchards. This operates to give a comparison of apple yields on apple acreage for the two groups; that part of the area on which fillers were planted being excluded.

The average yield on the orchards containing filler was 32 boxes per acre less than the average yield of the non-filler group. At least part of the lower yield results from filler trees being left too long in the permanent planting, thus robbing the apple trees of plant food and moisture they would normally receive. Of late years profits from filler fruits have often exceeded those from apples. Under such conditions the grower is reluctant to sacrifice the profitable filler trees, even when they remain to the detriment of the apple planting.

The orchards without fillers averaged a higher per cent of Extra Fancy and Fancy apples and a lower per cent of "C" grade than the filler orchards. The crowded condition of filler orchards produces an excess of shade, resulting in difficulty in obtaining the color requirements for the Extra Fancy grade.

Table 13 shows the non-filler orchards producing apples of somewhat larger size than the filler group, a result of the competition between fruits in filler orchards.

Labor costs tend to be somewhat higher where filler trees are used. Cultivation is accomplished with more difficulty when working around the extra number of trees. The handling of spray hose is more cumbersome for the same reason. Where pear trees are used as fillers some growers spray them each time the apples are sprayed, thus wasting spray material and adding to production costs.

The main advantage in the use of filler trees comes from their earlier returns, which help finance the apple crop into bearing. The grower wishing to gain this advantage would possibly do better to plant only apple trees on the larger part of his acreage, giving them whatever spacing he wishes for his permanent planting. The "filler" trees could

Table 13. A Comparison of Results Obtained on 37 Orchards Set Only to Apples With 43 Orchards Containing Filler Trees, Yakima District, 1928 Crop Year

	43 orchards with filler trees	37 orchards without filler trees
Number of acres averaged.....		
Average yield per acre.....		
Quality study:		
Average per cent Extra Fancy.....	33.89%	36.82%
Average per cent Fancy.....	37.39%	37.06%
Total Extra Fancy and Fancy.....		
Average per cent C Grade.....	26.38%	23.60%
Average per cent other grades.....	2.34%	2.52%
Total C Grade and other.....		
Size study:		
88's and larger.....	7.88%	11.03%
96's to 125's.....	34.33%	33.58%
Total larger sizes.....		
138's to 163's.....	36.20%	34.82%
175's and smaller.....	21.59%	20.57%
Total smaller sizes.....		
	57.79%	55.39%

*This acreage has been reduced to exclude that portion of the area on which filler trees are growing, leaving an acreage comparable to that on non filler orchards.

then be planted on the balance of the tract as a solid block of fruit, being spaced more closely, since most of the soft fruits require less ground space than apple trees.

Under this system neither crop robs the other, and the early returns are received just as surely as when the trees are used as fillers. The soft fruit trees may then be left as long as they are profitable without injury to the apple crop and may be pulled and apples planted in their stead whenever conditions warrant the change.

The future outlook for soft fruit production, as discussed in Bulletin 238 of this station, is not promising, and it is probable that there will be less advantage in the use of filler trees in the future than there has been in the past.

FIXED AND VARIABLE COSTS

Production costs may be divided into fixed and variable costs. Fixed costs as used in this study are all those that do not vary with yield. Land tax, interest on investment, depreciation on equipment, pruning, irrigating and spraying are items typical of fixed costs. Variable costs are those that do vary with yield, such as repairs to equipment, thinning, propping and all harvest labor.

Figure 5 illustrates the relative importance of these two types of charges with varying yields per acre.

When 200-box yields are produced, fixed charges make up almost two-thirds of the entire cost of production. When 1,000-box yields are obtained, fixed costs constitute but little over one-fourth the total cost. As yields increase fixed costs decrease in importance when compared with the total cost of production. Since fixed costs must be met regardless of yield, high costs per box result when yields are so low that but few boxes bear the burden.

The fixed costs on the per acre basis are really the varying factors when figured on the box basis. Land tax, for instance, is the same per acre regardless of yield obtained, but when shared by 200 boxes the charge is much greater per box than when 1,000 boxes share in the cost.

While it seems awkward to call "fixed," the charges that obviously vary when computed on the per box basis, the same nomenclature will be used throughout. By using this method, the black part of each bar, either per box or per acre, contains the same charges.

The lessons which may be learned from Figure 5 are these:

1. As yield increases **total** cost per acre also increases, but under normal conditions and within normal limits, the cost of producing each box grows less.
2. Fixed costs are the charges that cause high per box costs when yields are too low to bear the burden.
3. Fixed costs grow less important with increasing yields.

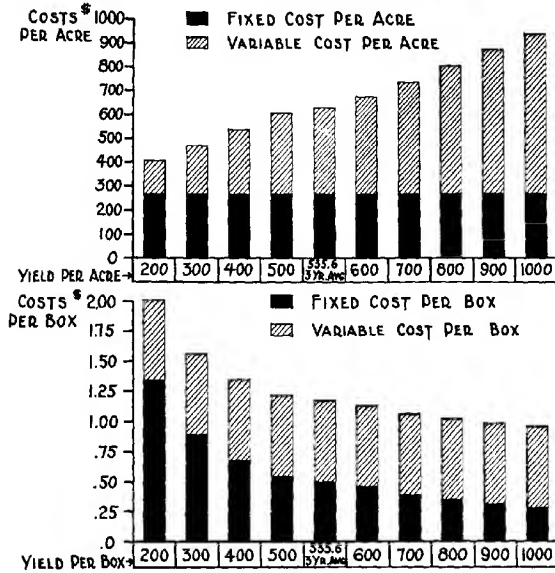


Fig. 5. Relative Importance of Fixed and Variable Costs with Different Yields in the Wenatchee District.

For the three-year period, 1926-'28, fixed costs made up 42.52 per cent and variable costs 57.48 per cent of the average cost of production on the orchards studied in the Wenatchee District. This was with the average yield of 535.6 boxes per acre.

RELATIVE IMPORTANCE OF DIFFERENT ITEMS OF COST

Figure 6 shows the relative importance of the main items making up the average cost of production of apples on the farms studied in the Wenatchee District.

Overhead expense, making up 29.91 per cent of the cost, is composed of interest on land; interest, depreciation and repairs on buildings, equipment, and irrigation system; land and water taxes, and minor items. Once the permanent investments are made, the grower has either helped or hindered his chances for success in each year of production that the investment lasts. Since most of the overhead charges are fixed costs, especial care should be taken at the time of investment to keep them as low as is consistent with good management. Such costs on the small orchard may be kept down by renting equipment instead of purchasing; by buying it secondhand; by buying and working out with the equipment; or by purchasing in partnership with another grower having a small orchard. Owning in partnership, however, is seldom satisfactory if the machine purchased must be used at a cer-

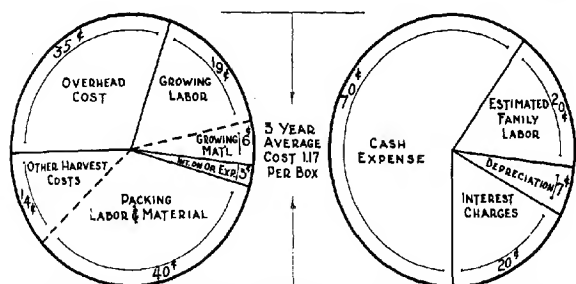


Fig. 6. Segregation of the three-year average per acre and per box costs of producing apples on 81 farms in the Wenatchee District, into their component parts.

tain specific time for best results. Brush rakes, discs and ditchers are well adapted to joint ownership, while spray outfits ordinarily are not.

Packing labor and material make up 34.19 per cent of the total cost; this operation has been largely removed from the grower's hands on account of the spray residue problem previously discussed.

Picking, hauling and all other harvest expenses, amount to 11.97 per cent of the total cost of production.

Growing material makes up 5.13 per cent and interest on the season's operating expenses 2.56 per cent of the total cost. This leaves 19 cents, or only 16.24 per cent of the total cost which is expended in the labor of growing the crop.

For the grower who packs and markets through some central agency,

the effective field for cost reduction is almost limited to the labor of growing the crop and delivering it to the warehouse. Thus he controls an average of less than 30 per cent of the cost of a packed box of fruit. Ways and means of cutting costs within this sphere are discussed in later paragraphs.

The second half of Figure 6 divides the costs into other segregations. Assuming thinning, picking and packing to be hired done and the balance of the labor performed by the family on the average sized orchard, a charge of 20 cents per box or 17.09 per cent of the total cost remains for family labor. Depreciation on buildings, equipment and irrigation system constitutes seven cents or 5.99 per cent of the cost of production. Interest charges on the various investments amount to 20 cents or 17.09 per cent of the total cost. This leaves an average of 70 cents or 59.83 per cent of the total cost as cash expense which approximates the figure the average grower considers to be his production cost.

EFFECT OF YIELD AND PRICE ON NET RETURNS TO THE GROWER

Table 14 is based on the three-year average cost of producing apples as found on 81 farms in the Wenatchee District. Fixed costs remain the same on each acre regardless of the yield produced. Most variable costs increase or decrease nearly in direct proportion to the yield obtained. The 200-box yield is 37.34 per cent of the three-year average yield of 535.6 boxes per acre. Hence it is assumed that the variable costs for a 200-box yield will be 37.34 per cent of the three-year average variable cost of \$360.39, or \$134.57 per acre. All cost figures in Table 14 have been calculated from the average per acre costs in this manner.

Per box costs varied from \$2.01 on a 200-box yield to 94 cents on a 1000-box yield per acre. When returns are 75 cents per box even 1,000-box yields are produced at a loss. With a \$1.00 return per box, yields between 800 and 900 boxes begin to show some measure of profit. At \$1.25 per box yields between 400 and 500 boxes per acre will break even and with returns of \$2.25 even a 200-box yield results in a profit of 24 cents per box. For this computation the entire cost has been used, including interest on all investments and any physical labor expended by the operator or his family in crop production. Eliminating

Table 14. Effect of Yield and Price on Net Returns per Box of Apples, Wenatchee District, Three-Year Average

Yield in boxes per acre	Fixed costs per acre	Variable costs per acre	Total costs per acre	Cost per packed box delivered warehouse	Varying price assumptions						
					Net returns per box when price is:						
					75c	\$1.00	\$1.25	\$1.50	\$1.75	\$2.00	\$2.25
200	\$266.54	\$134.57	\$401.11	\$2.01	\$-1.26	\$-1.01	\$-.76	\$-.51	\$-.26	\$-.01	\$0.24
300	266.54	201.85	468.39	1.56	-.81	-.56	-.31	-.06	.19	.44	.69
400	266.54	269.14	535.68	1.34	-.59	-.34	-.09	.16	.41	.66	.91
500	266.54	336.42	602.96	1.21	-.46	-.21	.04	.29	.54	.79	1.04
*535.6	266.54	360.39	626.93	1.17	-.42	-.17	.08	.33	.58	.83	1.08
600	266.54	403.71	670.25	1.12	-.37	-.12	.13	.38	.63	.88	1.13
700	266.54	470.99	737.53	1.05	-.30	-.05	.20	.45	.70	.95	1.20
800	266.54	538.31	804.85	1.01	-.26	-.01	.24	.49	.74	.99	1.24
900	266.54	605.60	872.14	.97	-.22	.03	.28	.53	.78	1.03	1.28
1000	266.54	672.88	939.42	.94	-.19	.06	.31	.56	.81	1.06	1.31

*Three-year average cost found on 81 farms, Wenatchee District, from which other costs are computed.

all interest charges to leave only those costs the grower must meet each year, and using the above method of calculation, together with average returns to growers in the Wenatchee District for the six-year period of 1922-'27, the number of boxes necessary to break even in the production of the main apple varieties has been calculated and is discussed on page 61.

Table 15. A Study of the Ten Orchards Producing at the Highest Cost and the Ten Producing at the Lowest Cost Out of the 81 Orchards Surveyed in the Wenatchee District Over the Three-Year Period of 1926, 1927 and 1928

	Ten producing at the highest cost	Ten producing at the lowest cost
Average acres bearing apples per orchard.....	11.12 acres	10.55 acres
Average yield per acre.....	382.8 boxes	711.7 boxes
Average investment per acre in:—		
Land	\$1,385.61	\$1,146.23
Equipment	117.39	144.92
Buildings	99.98	87.98
Irrigation system.....	28.10	51.69
	Costs per acre	Costs per box
	Ten highest cost orch.	Ten lowest cost orch.
Overhead costs	\$183.53	\$180.45
Cultural material costs	28.26	31.88
Cultural labor costs	121.26	110.19
Interest on operating exp. for season....	12.91	17.26
Miscellaneous fruit returns (credited)....	1.16	2.77
Harvest costs	226.71	379.11
Total cost, excluding interest on land....	\$488.37	\$647.35
Total cost including interest on land.....	571.51	716.12
Total receipts	\$458.59	\$984.83
Net profit		268.71
Net loss	112.92	.295

A STUDY OF ORCHARDS PRODUCING AT CONSISTENTLY HIGH OR LOW COSTS

Table 15 is a study of the 10 orchards which produced at the lowest average cost over the three years of the study compared with the 10 producing at the highest cost; both classes being selected from the 81 farms studied in the Wenatchee District.

Each group averaged about 10 acres in bearing apples per orchard. The widest variation between groups was in the yields obtained per acre; that of the low cost orchards being almost double the average yield of the high cost farms. The orchards producing at high costs showed the usual tendency to overvalue their land. Investments in equipment and irrigation system, on the other hand, are higher on the low cost orchards. It is probable that returns have been so meager on the high cost group that they have been unable to equip for efficient performance of work.

An important variation in costs is found in cultural labor. With nearly twice the average yield of the high cost orchards, the low cost group was still able to grow the crop at \$11 per acre less than the cost for the high cost group. This would indicate better managerial ability and greater efficiency in the performance of orchard work on the low cost farms. These figures are more striking when comparisons are made on the per box basis, readily demonstrating the influence of yield on cost of production.

Over the three-year period the low cost farms produced apples 48 cents per box cheaper than the high cost group. These farms made money in even the poor year of the study while the high cost orchards produced at a loss, except in 1927, an abnormally good year from the standpoint of returns.

WAYS AND MEANS OF CUTTING THE COST OF PRODUCTION

No single factor has as much influence on the cost of producing a box of apples as the yield obtained. With increasing yields, production costs tend to decrease. This advantage is fully effective only when the yields are obtained by normal methods of production. Excessive applications of fertilizer and abnormal amounts of labor tend to raise the cost and reduce the margin of profit which would have resulted had the same yield been obtained by normal cultural practices.

Some growers will object to striving for high yields lest the grim spectre of "overproduction" be lurking near and descend "like the wolf on the fold." Were all growers able to increase their yields at will, such fears might be well grounded. Conditions of soil, climate, and management will always limit the yields obtained on the majority of

orchards, preventing any large increase in yield which might be attributed entirely to the growers' own efforts. High yields per acre are desirable except under one abnormal condition. When returns are lower than the cash expense incurred in growing, harvesting, and marketing the fruit, each box is produced at a distinct loss, and additional boxes only add to the loss borne by the grower. Such conditions are uncommon in the industry.

Land investment should be kept as low as possible, for once incurred, this investment remains as a help or hindrance in each year of production. Orchard land cheaply valued is not, however, always the best investment. If the low valuation is due to poor varieties, old trees, depleted soil, frost pockets, hail belts or similar factors, the low price may prove very dear indeed. On the other hand, land valued as high as \$2,000 per acre because of high yielding capacity and choice varieties has been known to pay for itself from the returns of one or two years crops. This is the extreme, but certainly the grower's chances for "paying out" under such conditions are much better than under those previously described.

The investment in equipment should be kept as low as possible and still insure efficient performance of the orchard work. Equipment once purchased brings a certain inevitable charge for interest, depreciation, and repairs which much be borne in the year of crop failure as well as in the good year.

Green and Gray own 10-acre orchards joining each other. They both decide to equip with stationary spray plants. Green, in the height of enthusiasm, calls in the salesman and contracts for the purchase of a steel tank, electrically driven power unit, and pipe, at a cost of \$1,300. Gray looks over his portable rig, still in good condition, and remembers that Green purchased his at the same time. With very little dickering he purchases Green's portable outfit for \$50. Removing the tanks from both portable rigs he mounts them on a concrete base, purchases a Ford engine for a power plant, lays his pipe and is ready to do business at a net cost of \$800. He then contracts to furnish power to neighbor White, who owns five acres joining him on the west. This revenue further reduces the yearly cost of the spray plant to him.

In the fall Green and Gray both need new trucks to haul their fruit. Green buys a new six-cylinder ton truck and after 15 days of hauling

and 15 days of odd jobs around the place, lays the truck up for the winter. Gray purchases a new four-cylinder truck and after his 15 days of hauling spends a month hauling for other people. After a few years of such practices Green is dragging an overhead of 15 cents per box for equipment while Gray's overhead is only five cents per box for this item.

The same care should be exercised in investing in buildings and irrigation system. Many growers today are carrying the burden of investments in packing sheds and packing equipment which is no longer used since central packing became almost compulsory for the small grower. Depreciation charges on buildings, equipment and irrigation system may be lowered by taking exceptional care of these items, thus prolonging their life and increasing their efficiency.

The cost of cultural materials may be cut by buying in quantity lots. For the small grower this is accomplished by purchasing through his marketing agency or by pooling his order with other small growers and dealing direct with the manufacturer.

Cultural labor costs are only reduced when the grower is alive to the adoption of new methods. In comparing his labor costs with the average costs as given in this study considerable variation may be expected. If, however, the grower's costs vary widely from the average figure, there should be some plausible reason for the variation, and a little thought might result in disclosing the weak spots in his production methods. Much can be learned by visiting other growers in his own district and in other districts and learning the methods others use in performing the orchard tasks.

Where labor is hired, the judgment displayed by the grower in selecting his crew and his ability as a manager are evidenced by the cost of the completed job. Experienced help is much to be preferred over transient labor.

Economies in hauling box shook may be realized by hauling a load when in town for some other purpose, which is cheaper than the cost of a special trip. If the shook is hired hauled, the grower may sometimes have it hauled free of charge by promising his apple hauling in the fall to the same party. This condition is becoming more common as competition for hauling contracts increases with the number of men bidding for the work.

In picking the perishable crop the grower would do better to spend all his time in seeing that the fruit is handled with care unless the crew is experienced and well known to him.

In the past, fruit was "yarded out" of the orchard with teams and sleds and stacked at the roadside, where it was picked up by trucks. Some growers remove the windshield and cab of their trucks and load directly from the orchard, saving one handling of the fruit and thus reducing costs. Some organizations are working out a definite hauling schedule for each grower, thus eliminating the long waits in line when delivering fruit to the warehouse.

While it is doubtful if the same attention can be hired at the central packing plant, it would seem cheaper for the grower under present conditions to have his fruit central packed. The washing equipment now in general use is too expensive to be purchased by the average grower. The grower who ranch packs seldom includes interest or depreciation on his packing shed and equipment when figuring his ranch packing cost. Were these items included, his packing costs would probably be nearly as much as the charge made by the large marketing organization for the same job.

RELATIVE PROFITS FROM THE DIFFERENT APPLE VARIETIES

Yield Per Tree By Variety

Nearly all comparisons of relative profits from different apple varieties have been based on the prices received for each variety. This basis is inadequate since it is possible that a variety receiving relatively low returns but having superior yielding qualities might return a larger net profit per acre than one on which returns were high but the yield low. Average yield per tree should be considered together with returns to discover those varieties which are most profitable.

Growers in both districts gave the number of trees of each variety that were bearing in their orchards in each year of the study. Dividing the total production of a given variety by the total trees that bore the crop, average yields per tree were obtained for the main varieties. These averages are presented in Tables 16 and 17. The number of trees making up each average figure are given as an indication of the reliability of the figure.

Table 16. Average Yield in Packed Boxes per Tree by Varieties, Wenatchee District, 1926-1928 Inclusive

Variety	3-year average		1926		1927		1928	
	Number of trees	Yield per tree	Number of trees	Yield per tree	Number of trees	Yield per tree	Number of trees	Yield per tree
Arkansas Black.....	111	11.18	127	11.60	98	9.39	108	12.31
Rome Beauty.....	1,835	9.89	1,916	8.79	2,056	8.24	1,534	13.48
Delicious.....	5,844	9.12	5,852	8.91	6,158	7.31	5,523	11.37
Winter Banana.....	648	8.87	660	9.68	643	5.54	641	11.37
Jonathon.....	4,072	8.58	4,289	8.97	4,191	6.46	3,737	10.52
Winesap.....	11,327	8.51	11,937	7.67	11,901	7.63	10,143	10.53
White Winter Pearmain.....	329	8.30	416	8.04	405	7.04	165	12.04
Stayman.....	1,193	8.26	1,234	7.42	1,247	7.72	1,098	9.81
Yellow Newtown.....	222	7.00	219	5.60	199	5.59	247	9.38
Average above varieties.....	25,581	8.75	26,650	8.28	26,898	7.36	23,196	10.92

Table 17. Average Yield in Packed Boxes per Tree by Varieties, Yakima District, 1926-1928 Inclusive

Variety	3-year average		1926		1927		1928	
	Number of trees	Yield per tree	Number of trees	Yield per tree	Number of trees	Yield per tree	Number of trees	Yield per tree
Arkansas Black.....	272	10.39	226	13.90	239	8.73	352	9.26
Stayman.....	121	10.35	72	11.99	129	8.20	163	11.34
Delicious.....	2,509	8.53	2,290	8.50	2,537	5.75	2,701	11.15
Winesap.....	15,269	7.89	12,088	8.01	16,092	7.17	17,627	8.45
King David.....	167	7.72	108	7.85	219	5.17	173	10.87
Rome Beauty.....	5,469	7.53	4,433	6.52	5,935	7.12	6,039	8.68
Winter Banana.....	275	7.16	279	8.06	271	4.96	274	8.43
Jonathan.....	7,208	7.15	6,871	8.53	7,133	5.28	7,619	7.66
Spitzenberg.....	274	6.40	274	8.82	253	4.87	296	5.46
Yellow Newton.....	1,530	5.40	1,310	5.55	1,732	3.71	1,547	7.17
Average above varieties.....	33,094	7.61	27,951	7.89	34,540	6.46	36,791	8.48

Yields per tree will vary widely from farm to farm. Such factors as tree spacing, age of trees, soil adaptation to the variety, location in frost pockets, hail belts, or areas badly infested with scale or worms, elevation, and the cultural methods of different growers all make for wide variation in yield on the same variety. For this reason Tables 16 and 17 cannot be expected to apply to the local condition of each grower. They are presented rather, to demonstrate a method which the grower may follow under his own conditions, of ascertaining the most profitable varieties. To obtain this information the grower must keep an accurate count of the number of bearing trees of each variety for each year. The longer records are kept the more trustworthy will this data become for his guidance.

A comparison of the yearly yields of Tables 16 and 17 shows the tendency of certain varieties toward alternate bearing.

Profits Per Tree on Important Varieties in the Wenatchee District

Table 18 is based on the yields per tree of Table 16. From the three-year average cost of producing a box of apples in the Wenatchee District the per box costs have been calculated on the various yields of the varieties shown in the table. As previously discussed, fixed costs on the acre basis become variable when placed on the per box basis. The six-year average returns listed in Table 18 are preliminary figures from a study of Washington apple prices being made by Chester C. Hampson of this department. Production costs varied from \$1.06 to \$1.13, while returns varied from 96 cents to \$1.81 on the different varieties. The three varieties produced at a profit were the Delicious, Winter Banana and Winesap, listed in order of relative profits. Of the three varieties produced at a loss, the Jonathan showed the greatest loss, followed in order by the Stayman and the Rome Beauty. Differences are more apparent when comparisons are made on the per tree and per acre basis. A wise selection of varieties is without doubt one of the most important factors in producing apples at a profit.

Yields per tree and prices received are necessarily chapters from past history. The wise grower will also obtain all possible information on the future outlook for the variety in question before making heavy plantings.

Table 18. Relative Profits From Different Varieties of Apples, Wenatchee District

	3-year average in packed per tree 1926-28	3-year average cost of production per box (1926-1928)		46-yr. average return 1922-27	Net returns				Per acre (69.67 trees per acre.)		
		**Fixed cost per box	Variable cost per box		Total per box	Per box		Per tree		Profit	Loss
						Profit	Loss	Profit	Loss		
Rome Beauty	9.89	\$0.39	\$0.67	\$1.06	.....	\$0.10	.....	\$0.99	.....	.....	\$68.97
Delicious	9.12	.42	.67	1.09	.....	\$0.72	.....	\$6.57	.....	\$457.73	.....
Winter Banana	8.87	.43	.67	1.10	.24	.....	2.13	.....	.....	148.40	.....
Jonathan	8.58	.45	.67	1.12	.....	.16	.....	1.37	.....	.....	95.45
Winesap	8.51	.45	.67	1.12	.21	.....	1.79	.....	.....	124.71	.....
Stayman	8.26	.46	.67	1.13	.....	.11	.....	.91	.....	.....	63.40
3-year average*	7.69	.50	.67	1.17	.12	.....	.92	.....	.....	64.10	.....

*Average 3-year yield and cost found in Wenatchee District on which adjusted costs for above varieties are based.

Number of Boxes Necessary to Break Even With Production Costs on Different Varieties in the Wenatchee District

Using the six-year (1922-'27) preliminary apple prices for the various varieties in the Wenatchee District as computed by Chester C. Hampson, and the three-year (1926-'28) average cost of production as found in this study, the number of boxes per acre of each variety which must be produced to just break even have been calculated. For this study all interest charges on investments in land, buildings, equipment and irrigation system have been excluded from the cost figures, leaving only those charges which the grower must actually meet each year. Since the yields presented in Table 19 are those necessary to **break even** with production costs for each variety, yields greater than those given are necessary for any measure of profit.

Yields on the last four varieties of Table 19 are obviously beyond

Table 19. Number of Boxes of Apples That Must Be produced per Acre to Break Even on Different Apple Varieties, Wenatchee District

Apple variety	Yield per acre necessary to break even, boxes	*Cost of production per box	†Return per box
Delicious	152	\$1.81	\$1.81
Winter Banana	258	1.34	1.34
Winesap	262	1.33	1.33
Arkansas Black	317	1.22	1.22
Yellow Newtown	324	1.21	1.21
Spitzenberg	403	1.10	1.10
Stayman	497	1.02	1.02
King David	532	1.00	1.00
**3-yr. average figures...	536	1.00	.....
White Winter Pearmain	595	.96	.96
Rome Beauty	599	.96	.96
Jonathan	607	.96	.96
Grimes Golden	1035	.84	.84
Black Twig	1157	.82	.82
Black Ben	1915	.76	.76
Ben Davis	4201	.71	.71

**Three-year 1926-28, average figures on 81 farms, Wenatchee District.

*Costs computed from average costs found in survey. Interest charges on investments in land, buildings, equipment and irrigation system have been excluded, leaving only those costs which the grower must actually meet each year.

†Prices are preliminary average figures taken from a 6-year (1922-27) study of Washington apple prices being conducted by Chester C. Hampson of this department. They are average prices for the Wenatchee District.

the attainment of the average grower and are presented to show how hopeless the case appears at present for these varieties. The first five varieties, however, should return some measure of profit to the average

grower, and on those orchards where consistently high yields are obtained, varieties further down the list might pay for their keep.

The grower desiring maximum profits in orcharding can well afford to study carefully yields and prices on the different varieties he is producing.

WHAT IS THE BEST SIZE OF ORCHARD?

There is no one best size of orchard for all conditions. Where climate and soil make for consistently high production larger acreages may be handled with less risk.

Where the grower has a large family, thus permitting him to weather through the poor year with little cash outlay for labor, there is comparatively little risk in farming up to the capacity of the home labor supply.

Larger acreages are less risky when the varieties commanding higher prices are produced.

Small acreages are always handicapped in equipping for efficient performance of work. If equipment is purchased, too heavy an overhead charge must be carried. If the work is hired, it is frequently performed too late to be most effective. The one who hires out naturally does his own work when it should be done and hires out afterward. Trouble may be had in the purchase and operation of secondhand equipment unless one has unusual ability as a mechanic. Joint ownership is not always satisfactory unless neighbors are unusually accommodating.

As the acreage increases, overhead costs on all types of equipment decrease. This holds true till duplication of equipment becomes necessary, when much of the former advantage may be lost.

As acreage increases, less attention can be given to each tree and yields tend to decrease. With decreasing yields per box costs of production increase.

The most common sizes of orchards in both districts are from 10 to 15 acres. It is probable that this size is not far wrong, since it has resulted from the experience of many growers.

The history of apple production shows an irregular alternation of good and poor years. Under such conditions the average grower would

operate with less risk were he to confine his acreage to that on which the bulk of the work can be performed, if need be, by family labor. Those willing to chance a loss in the unfavorable years for the sake of larger profits in favorable years by operating a larger area, should protect themselves by locating in a favorable district, and give careful attention to a wise selection of varieties.

Table 20 shows some of the factors influenced by size on 63 orchards in the Wenatchee District. Available records of orchards in sizes above and below those given were too few to produce trustworthy averages.

Table 20. Influence of Size of Orchard on Costs and Returns (Three-year Average Figures, Wenatchee District)

	Size groups	
	4 to 11.9 acres	12 to 19.9 acres
Number of farms averaged.....	41 orchards	21 orchards
Average acres bearing apples per farm	7.1 acres	14.8 acres
Average per acre cost for equipment, buildings, and irrigation system	\$102.16	\$77.11
Cultural labor costs per acre.....	\$109.61	\$106.69
Total cost per acre to harvest time, excluding interest on land.....	\$286.96	\$254.00
Total cost per acre delivered at warehouse, excluding interest on land	\$626.16	\$594.19
Average yield per acre	575.2 boxes	553.0 boxes
Average cost per packed box.....	\$1.089	\$1.075
Average gross returns per box.....	\$1.305	\$1.316
Average profit per box.....	\$0.216	\$0.241

LABOR EXPENDITURES IN APPLE PRODUCTION

Tables 21 and 22 show the average amounts of labor expended in the performance of the different jobs in growing the apple crop. Methods of performing the same task vary widely on different farms. In spraying, many growers use a portable spray rig, horse drawn; others use the portable rig drawn by a tractor; and still others use stationary outfits. Since most of the labor can be divided into team work and tractor work, these tables have been prepared to indicate the average labor expenditures for each job under both conditions. The number of acres are given on which each average is based. In Table

21 the average of 52.9 man hours for pruning is based on 1,035.9 acres. Since 1,035.9 acres are all the acres embraced by the study (as indicated at the top of the table), the pruning average is based on 100 per cent of the data. Table 22 for the Yakima District has been based on only those farms which contained no filler trees. These tables may be of use to the grower who is enlarging his plantings by giving some idea of the probable labor demands with larger acreages.

For those unfamiliar with orchard work a description of the various jobs listed in the tables is given:

Pruning: Trimming out dead or superfluous wood from the trees.
Brush disposal: Picking up and hauling out the brush caused by pruning.
Cultivating: Discing, springtoothing, subsoiling or plowing the ground.
Ditching: Making the furrows by means of which irrigation water is conveyed from tree to tree.
Irrigating: The labor involved in caring for the irrigation water.
Dormant spraying: The labor in spraying in early spring before the blossoms or leaves come out.
Cover spraying: The labor of applying sprays during the growing season.
Cutting sprouts: The removal of new shoots that otherwise would develop into superfluous branches.
Thinning: The removal of a portion of the fruit while still small, to throw all the tree's resources into the production of a normal amount of larger and better quality fruit.
Propping: The placing of supports under the main limbs of the trees to prevent their breaking under heavy loads of fruit.
Cleaning up orchard: Removing boxes, ladders, and props from the orchard after harvest and otherwise straightening things up ready for winter.
Hoeing around trees: Clearing the cover crop away from the base of the tree to prevent mouse injury during the winter months.

The labor expended in normal years on the various jobs does not vary widely, except for thinning and propping, which are governed by the size of the crop. Nearly all other operations in growing the crop must be performed in about the same manner even in the year of crop failure, to insure a crop for the following year.

In 1926 there were many more stationary spray plants in use in the Wenatchee District than in the Yakima area. Since then, Yakima growers have been installing them quite rapidly.

An average of five cover sprays was applied in both districts and approximately two cultivations were given per year. The average cost of a man hour was 40 cents on the farms studied in the Wenatchee District and 38 cents in the Yakima area. The average cost of a horse hour was 18 cents in the Wenatchee Valley and 14 cents on the farms studied in the Yakima District.

CRAB OR APPLES, Wenatchee District, 1926

82 farms—1035.9 acres full bearing apples

Operation	Acres averaged	Horse operations		Acres averaged	Tractor operations	
		Hours per acre			Hours per acre	
		Man	Horse		Man	Tractor
Pruning.....	1035.9	52.9	.....	.....	.....	.....
Brush disposal.....	407.6	8.9	8.4	195.0	7.3	3.1
Cultivating.....	76.5	3.8	7.6	392.5	2.9	2.9
Ditching cut.....	377.9	2.6	3.7	436.0	1.6	1.2
Irrigating.....	1035.9	44.9	.....	.....	.....	.....
Dormant spray labor*.....	213.7	5.5	4.4	52.0	6.2	3.1
Cover spray labor†.....	222.7	24.2	18.7	52.0	21.2	10.8
Cutting sprouts.....	751.6	6.9	.....	.....	.....	.....
Thinning.....	1035.9	74.9	.....	.....	.....	.....
Propping.....	656.5	6.8	7.0	162.5	5.7	3.6
Cleaning up orchard.....	420.7	5.3	5.6	183.5	5.3	3.5
Applying fertilizer or manure.....	461.6	2.2	3.3	154.0	3.5	1.6
Hoeing around trees.....	568.9	4.6	.....	.....	.....	.....
Miscellaneous.....	623.2	5.7	.....	.....	.....	.....

*Dormant spray on 675.9 acres with stationary outfit—4.8 man hours per acre.
†Cover spray on 675.9 acres with stationary outfit—25.8 man hours per acre.

Table 22. Labor Expenditure Per Acre of Apples, Yakima District—1926
*49 farms—653 acres full bearing apples

Operation	Acres averaged	Horse operations Hours per acre		Acres averaged	Tractor operations Hours per acre	
		Man	Horse		Man	Tractor
Pruning.....	653.0	37.9	.....	.....	.....	.....
Brush disposal.....	321.0	10.9	12.3	108.0	5.7	2.9
Cultivating.....	89.0	4.7	10.0	281.0	3.4	3.4
Ditching out.....	305.0	2.8	5.0	197.0	1.6	1.5
Irrigating.....	653.0	33.0	.....	.....	.....	.....
Dormant spray labor.....	376.5	5.3	4.8	146.0	5.1	1.9
Cover spray labor.....	366.5	23.4	22.4	156.0	24.5	9.0
Cutting sprouts.....	490.5	4.9	.....	.....	.....	.....
Thinning.....	644.0	63.6	.....	.....	.....	.....
Propping.....	399.0	5.0	6.7	46.0	1.8	1.8
Applying fertilizer or manure.....	303.5	3.9	7.6	80.0	1.6	1.4
Hoeing around trees.....	338.0	6.2	.....	.....	.....	.....
Miscellaneous.....	218.5	7.0	.....	.....	.....	.....

*These averages were set only to apples, no filler trees.

APPENDIX

Table 23. Relative Importance of Various Apple Varieties in Washington¹ at Different Planting Periods²

Variety	1925-27	1915-24	1905-14	1895-04	1885-94
	Per cent	Per cent	Per cent	Per cent	Per cent
Delicious.....	*47.56	45.46	12.84	7.60	.97
Winesap.....	32.09	25.15	32.89	22.42	.83
Rome Beauty.....	8.32	10.71	12.29	6.50	.....
Jonathan.....	1.64	5.86	20.08	10.67	.43
Winter Banana.....	.85	3.83	1.05	1.05	.29
Gravenstein.....	.53	1.00	.44	3.52	9.87
Yellow Newtown.....	.36	.57	5.02	4.30	.15
Arkansas Black.....	.23	.28	1.07	2.73	.20
Stayman Winesap.....	.17	1.35	3.54	2.24	.....
Esopus Spitzenberg.....	.13	.48	4.53	6.69	3.49
White Winter Pearmain.....	.11	.07	.43	.54	.04
Grimes Golden.....	.08	.12	.34	.54	.27
Tompkins King.....	.06	.17	.22	2.34	5.57
Northern Spy.....	.....	.11	.10	2.65	10.38
King David.....	.....	.14	.42	.46	1.74
All other varieties.....	7.87	4.70	4.74	25.75	65.77
	100.00	100.00	100.00	100.00	100.00

¹Calculated from data in U. S. D. A. Agricultural Yearbook for 1928, table 127, p. 763.

²During 1925-27, 47.56 per cent of the plantings for the period were of the Delicious variety. Figures for other varieties are to be interpreted in the same manner.

Table 24. Relative Importance of Different Varieties of Apples in Washington, Illinois and New York

Variety	State	Per cent of trees planted in:—			
		1895-04	1905-14	1915-24	1925-27
Delicious	Washington	*7.60	12.84	45.46	47.56
	Illinois	.58	2.82	12.58	15.75
	New York	.22	.64	7.08	5.44
Jonathan	Washington	10.67	20.08	5.86	1.64
	Illinois	19.35	19.24	15.24	13.19
	New York	.46	1.06	1.78	.27
Rome Beauty	Washington	6.50	12.29	10.71	8.32
	Illinois	1.67	.51	2.39	2.86
	New York	.95	1.89	4.67	1.26
Winesap	Washington	22.42	32.89	25.15	32.09
	Illinois	4.39	9.16	14.38	10.56

*Of all trees planted in Washington during the period 1895-04, 7.60 per cent were cultural Economics, "Marketing Northwestern Apples—Summary of 1928-29 Season," cultural Economics, "Marketing Northwestern Apples—Summary of 1928-29 Season," by A. E. Prugh and L. B. Gerry.

Table 25. Commercial Apple Production in Bushels. Leading States, 1923-28 Inclusive¹
(000 omitted)

State	1923	1924	1925	1926	1927	* 1928	6 year average	Per cent of 6-yr. av. U. S. production
Washington.....	28,800	18,825	26,010	25,950	22,302	30,000	25,315	25.62%
New York.....	12,600	11,214	18,750	18,000	8,163	12,690	13,570	13.73%
Virginia.....	5,850	7,560	4,320	11,100	4,950	11,100	7,480	7.57%
California.....	6,300	4,470	3,291	6,144	4,656	6,981	5,307	5.37%
Oregon.....	5,250	4,500	3,868	5,250	2,925	4,800	4,436	4.49%
Idaho.....	4,800	1,800	5,250	2,775	5,478	4,500	4,100	4.15%
Michigan.....	6,354	3,000	5,100	4,467	2,271	2,787	3,997	4.04%
West Virginia.....	4,200	2,400	2,247	5,100	4,050	4,410	3,735	3.78%
Illinois.....	4,200	3,300	3,645	3,870	2,250	3,720	3,498	3.54%
Pennsylvania.....	3,798	2,340	3,033	5,388	2,550	3,129	3,373	3.41%
Colorado.....	2,409	2,418	2,850	2,907	2,253	2,700	2,590	2.62%
Ohio.....	3,099	2,082	2,034	3,018	1,623	1,647	2,251	2.28%
United States.....	107,808	84,039	99,738	117,357	78,051	105,924	98,820	.....

¹ Preliminary figures.
Data from table 127, p. 765 of 1928 Yearbook of Agriculture (U. S. D. A.).

Table 26. *Size of Sample Studied in the Survey

Year	Item	Yakima District	Wenatchee District
1926	Number of orchards.....	90 farms	97 farms
	Acres in full bearing apples..	1,163.07 acres	2,130.96 acres
	Total yield in packed boxes..	572,523 boxes	900,506 boxes
1927	Number of orchards.....	91 farms	99 farms
	Acres in full bearing apples..	1,281.10 acres	2,468.72 acres
	Total yield in packed boxes..	514,166 boxes	942,846 boxes
1928	Number of orchards.....	91 farms	97 farms
	Acres in full bearing apples..	1,235.04 acres	2,394.19 acres
	Total yield in packed boxes..	645,717 boxes	1,304,359 boxes
Three-year average	Number of orchards.....	90.67 farms	97.67 farms
	Acres in full bearing apples..	1,226.40 acres	2,331.29 acres
	Total yield in packed boxes..	577,469 boxes	1,049,237 boxes

*Includes only those orchards on which costs have been figured. Net returns were studied on several orchards in each district on which cost figures were not available.

Costs per acre

	1926	1927	1928	3-yr. av.	1926	1927	1928	3-yr. av.
Cultural material costs								
*Dormant sprays.....	6.27	7.48	7.52	7.09				
*Cover sprays.....	12.25	12.83	14.40	14.81				
*Fertilizer and manure.....	7.33	8.11	10.90	8.78				
Miscellaneous.....	.22	1.24	1.39	.95				
Total cultural material cost.....	31.07	29.66	34.21	31.63	.062	.064	.053	.059
Cultural labor costs								
*Pruning.....	21.35	21.55	21.76	21.55				
*Brush disposal.....	4.65	5.00	4.01	4.56				
*Cultivating (disk, harrow or plow).....	2.57	2.43	2.70	2.57				
*Ditching out.....	1.37	1.41	1.44	1.41				
*Irrigating.....	18.12	17.54	17.07	17.58				
*Dormant spray labor.....	2.70	2.47	2.26	2.47				
*Cover spray labor.....	12.78	10.78	9.80	11.15				
*Cutting sprouts.....	2.10	2.01	1.55	1.89				
Thinning.....	30.22	23.86	40.18	31.36				
Propping.....	3.86	3.64	4.28	3.92				
Cleaning up orchard.....	1.93	1.76	1.71	1.80				
*Applying fertilizer or manure.....	1.29	1.21	1.13	1.21				
*Tracing around trees.....	1.05	.96	.80	.93				
Miscellaneous labor.....	2.61	3.01	1.81	2.48				
Total cultural labor cost.....	106.60	97.63	110.59	104.88	.214	.210	.171	.196
Interest on operating expense to harvest.....	5.66	5.58	6.20	5.81	.011	.012	.010	.011
Miscellaneous fruit returns (credited).....	2.38	.18	.70	1.08	.005	.001	.001	.002
Total cost ready to harvest excluding interest on land.....	249.30	246.83	270.97	255.63	.500	.531	.420	.477
Total cost ready to harvest including interest on land.....	322.66	322.98	348.85	331.43	.647	.695	.541	.619

*Costs that do not normally vary with yield.

Table 27. Cost of Producing Apples, Wenatchee District, 1926, 1927, and 1928 and Three Year Average Cost (Cont'd)

	Costs per acre				Costs per box			
	1926	1927	1928	3-yr. av.	1926	1927	1928	3-yr. av.
Harvesting costs								
Hauling shook					.005	.004	.004	.004
Picking					.081	.084	.083	.083
Hauling in and out of orchard					.024	.021	.018	.021
Hauling to warehouse					.018	.019	.021	.019
Supervising harvest labor					.013	.013	.008	.011
Packing (labor and material)					.384	.408	.399	.397
Miscellaneous harvest labor					.001	.000	.000	.001
Total harvesting costs	262.27	254.85	344.32	286.89	.526	.549	.533	.536
Interest on operating expenses during harvest	7.87	7.65	10.33	8.61	.016	.016	.016	.016
Total cost delivered at warehouse land, excluding interest on land	519.44	509.33	625.62	551.13	1.042	1.096	.969	1.029
Total cost delivered at warehouse land, including interest on land	592.80	585.48	703.50	626.93	1.189	1.260	1.090	1.171
Total receipts	503.45	825.87	741.72	691.50	1.010	1.777	1.149	1.291
Net profit	89.35	240.39	38.22	64.57	.179	.517	.059	.120
Net loss								
Total cash outlay ¹	448.45	440.54	550.35	479.47	.900	.948	.853	.895
Total depreciation charge	37.97	37.97	41.26	39.06	.076	.082	.064	.073
Total interest charge	106.38	106.96	111.89	108.40	.213	.230	.173	.203

¹Includes the labor of the operator, his family and his teams as cash outlay.

Table 28. Cost of Producing Apples on 17 Orchards Operated by Hired Ranch Managers, Wenatchee District. Years of 1926, 1927, and 1928 and Three Year Average

	1926			1927	1928	Three-year average
Number of orchards.....	17 farms			17 farms	16 farms	16.67 farms
Average acres bearing apples per orchard.....	66.4 acres			84.8 acres	87.0 acres	79.24 acres
Average yield in packed boxes per acre.....	355.10 boxes			323.01 boxes	472.4 boxes	384.61 boxes
Average per acre investment in land.....	\$758.89			\$811.55	\$841.03	\$806.90

	Costs per acre				Costs per box		
	1926	1927	1928	3-yr. av.	1926	1927	1928
Total cost to harvest excluding interest on land.....	\$212.81	\$255.77	\$295.99	\$257.65	\$.599	\$.792	\$.626
Total cost to harvest including interest on land.....	258.34	304.46	346.45	306.07	.727	.943	.733
Total cost delivered at warehouse, excluding interest on land.....	484.67	467.99	586.46	504.09	1.264	1.449	1.241
Total cost delivered at warehouse, including interest on land.....	494.20	516.68	636.92	522.51	1.392	1.600	1.348
Total receipts.....	352.52	528.20	501.73	468.84	.993	1.635	1.062
Net profit.....	141.68	11.52	135.19	83.67	.399	.035	.286
Net loss.....							.217
Total cash outlay.....	403.95	408.30	523.65	447.58	1.138	1.264	1.108
Total depreciation charges.....	19.57	28.77	30.36	26.70	.089	.089	.064
Total interest charges.....	70.68	79.61	82.91	78.23	.199	.247	.176

Year Average Cost

	1926			1927			1928			Three-year average		
	1926			1927			1928			1926		
Number of orchards.....	49 farms			45 farms			37 farms			43% farms		
Average acres bearing apples per orchard.....	14 acres			14.47 acres			13.84 acres			14.12 acres		
Average yield per acre.....	518.29 boxes			397.23 boxes			550.06 boxes			484.45 boxes		
Average investment per acre in:												
Land.....	\$990.33			\$938.63			\$980.94			\$976.57		
Equipment.....	72.17			82.45			96.25			84.32		
Buildings.....	95.14			104.42			105.50			101.30		
Irrigation system.....	30.25			28.42			30.85			29.77		
	Costs per acre			Costs per acre			Costs per box					
	1926	1927	1928	1926	1927	1928	1926	1927	1928	1926	1927	1928
Overhead costs:												
Land:												
*6% interest on investment.....	\$59.42	\$57.52	\$58.86	\$58.59	\$58.59	\$58.59	\$.115	\$.145	\$.107			\$.121
Equipment:												
*6% interest on investment.....	\$ 4.63	\$ 4.95	\$ 5.78	\$ 5.06	\$ 5.06	\$ 5.06						
*Depreciation.....	12.22	15.82	19.60	15.53	15.53	15.53						
Repairs.....	7.28	7.58	7.21	7.37	7.37	7.37						
Power (gas, oil, farm car, electricity).....	10.94	11.87	13.30	11.92	11.92	11.92						
Total equipment costs.....	\$35.07	\$40.22	\$45.89	\$39.88	\$39.88	\$39.88	\$.068	\$.101	\$.084			\$.082
Buildings:												
*6% interest on investment.....	\$ 5.71	\$ 6.27	\$ 6.34	\$ 6.08	\$ 6.08	\$ 6.08						
*Depreciation.....	4.70	5.06	5.76	5.12	5.12	5.12						
Repairs.....	.51	.45	.56	.51	.51	.51						
*Insurance.....	.98	1.06	1.29	1.09	1.09	1.09						
Total building costs.....	\$11.90	\$12.84	\$13.95	\$12.80	\$12.80	\$12.80	\$.023	\$.032	\$.025			\$.027
Irrigation system:												
*6% interest on investment.....	\$ 1.81	\$ 1.70	\$ 1.85	\$ 1.79	\$ 1.79	\$ 1.79						
*Depreciation.....	2.36	2.33	2.80	2.47	2.47	2.47						
Repairs.....	.27	.14	.35	.24	.24	.24						
Total irrigation system costs.....	\$ 4.44	\$ 4.17	\$ 5.00	\$ 4.50	\$ 4.50	\$ 4.50	\$.008	\$.011	\$.009			\$.009
Miscellaneous overhead charges:												
*Land tax.....	\$ 9.99	\$10.05	\$11.39	\$10.40	\$10.40	\$10.40						
*Water tax.....	9.57	9.14	8.89	9.23	9.23	9.23						
Crop insurance.....	1.44	1.32	1.22	1.34	1.34	1.34						
Liability insurance.....	.59	1.07	2.02	1.16	1.16	1.16						
Total miscellaneous overhead.....	\$21.59	\$21.58	\$23.52	\$22.13	\$22.13	\$22.13	\$.042	\$.054	\$.043			\$.046

	Costs per acre				Costs per box			
	1926	1927	1928	3-yr. av.	1926	1927	1928	3-yr. av.
Cultural material costs								
*Dormant sprays.....	\$ 6.56	\$ 5.30	\$ 6.22	\$ 6.02				
*Cover sprays.....	13.55	11.25	11.37	12.14				
*Fertilizer and manure.....	5.81	3.12	7.31	5.28				
Miscellaneous.....	37	1.29	1.46	.99				
Total cultural material costs.....	\$ 26.29	\$ 20.96	\$ 26.36	\$ 24.43	\$.051	\$.053	\$.048	\$.050
Cultural labor costs								
*Pruning.....	\$ 14.38	\$ 13.77	\$ 13.31	\$ 13.87				
*Brush disposal.....	4.70	4.28	3.50	4.22				
*Cultivating (disk, harrow, or plow).....	2.71	3.00	2.07	2.63				
*Ditching out.....	1.30	1.26	1.41	1.32				
*Irrigating.....	12.51	11.87	11.62	12.04				
*Dormant spray labor.....	2.50	2.47	2.50	2.49				
*Cover spray labor.....	11.52	10.82	9.95	10.84				
*Cutting sprouts.....	1.33	1.45	1.18	1.33				
Thinning.....	24.10	15.56	26.58	21.78				
Propping.....	2.45	1.69	1.66	1.96				
Cleaning up orchard.....		.08	.47	.16				
*Applying fertilizer or manure.....	1.74	1.18	1.15	1.38				
*Hoeing around trees.....	1.15	1.35	1.45	1.03				
Miscellaneous labor.....	.97	3.28	1.34	1.88				
Total cultural labor costs.....	\$ 81.36	\$ 72.06	\$ 77.19	\$ 76.93	\$.157	\$.182	\$.140	\$.159
Interest on operating expense to harvest.....	4.48	4.07	4.49	4.34	.008	.010	.008	.009
Miscellaneous fruit returns (credited).....	.86	.40		.46	.002	.001		.001
Total cost ready to harvest excluding interest on land.....	\$184.27	\$175.50	\$196.40	\$184.55	\$.355	\$.442	\$.357	\$.381
Total cost ready to harvest including interest on land.....	\$243.69	\$233.02	\$255.26	\$243.14	\$.470	\$.587	\$.464	\$.502

*Costs that do not normally vary with yield.

Table 29. Cost of Producing Apples, Yakima District, Orchards Set Only to Apples (Cont'd)

	Costs per acre					Costs per box				
	1926	1927	1928	3-yr. av.		1926	1927	1928	3-yr. av.	
Harvesting costs										
Hauling shook.....						\$.005	\$.005	\$.003	\$.004	
Picking.....						.082	.080	.081	.081	
Hauling in and out of orchard.....						.022	.022	.019	.021	
Hauling to warehouse.....						.022	.024	.018	.021	
Supervising harvest labor.....						.001	.009	.006	.005	
Packing (labor and materials).....						.390	.407	.394	.397	
Miscellaneous harvest labor.....							.003	.001	.001	
Total harvesting costs.....	\$270.42	\$218.28	\$287.18	\$256.69		\$.522	\$.550	\$.522	\$.530	
Interest on operating expense during harvest.....	8.11	6.55	8.62	7.70		.016	.016	.016	.016	
Total cost delivered at warehouse, excluding interest on land.....	462.80	400.33	492.20	448.94		.893	1.008	.895	.927	
Total cost delivered at warehouse, including interest on land.....	522.22	457.85	551.06	507.53		1.008	1.153	1.002	1.048	
Total receipts.....	512.28	623.60	582.69	570.98		.989	1.570	1.059	1.179	
Net profit.....		165.75	31.63	63.45		.019	.417	.057	.131	
Net loss.....	9.94									
Total cash outlay.....	418.78	353.57	436.97	400.85		.808	.890	.795	.827	
Total depreciation charge.....	19.28	23.22	28.16	23.12		.037	.037	.051	.048	
Total interest charge.....	84.16	81.06	85.93	83.56		.163	.204	.156	.173	

¹Includes the labor of the operator, his family and his teams as cash outlay.

Average yield bearing apples per orchard	11.64 acres	13.69 acres	13.72 acres	13.06 acres
Average yield per acre.....	454.82 boxes	405.61 boxes	520.56 boxes	459.90 boxes
Average investment per acre in:				
Land.....				
Equipment.....	\$999.62	\$1,012.58	\$1,019.36	\$1,011.35
Buildings.....	77.10	73.64	78.13	76.19
Irrigation system.....	73.32	66.76	66.86	68.62
	24.49	24.09	23.02	23.82

Table 30. Cost of Producing Apples, Yakima District; Orchards Containing Filler Trees (Continued)

	Costs per acre					Costs per box				
	1926	1927	1928	3-yr. av.		1926	1927	1928	3-yr. av.	
Cultural material costs:										
*Dormant sprays.....	\$ 4.90	\$ 5.26	\$ 5.25	\$ 5.15						
*Cover sprays.....	10.54	8.91	10.28	9.85						
*Fertilizer and manure.....	4.64	3.23	6.05	4.62						
Miscellaneous.....	.08	.29	.37	.26						
Total cultural material cost.....	\$ 20.16	\$ 17.69	\$ 21.95	\$ 19.88	\$.044	\$.042	\$.043			
Cultural labor costs:										
*Pruning.....	\$ 13.00	\$ 13.29	\$ 12.05	\$ 12.77						
*Brush disposal.....	5.45	5.05	3.75	4.70						
*Cultivating (disk, harrow or plow).....	4.12	3.76	3.05	3.61						
*Ditching out.....	1.77	1.74	1.41	1.63						
*Irrigating.....	14.63	13.87	13.34	13.90						
*Dormant spray labor.....	2.50	2.56	1.95	2.33						
*Cover spray labor.....	11.30	11.80	9.38	10.81						
*Cutting sprouts.....	1.14	.96	.79	.95						
Thinning.....	21.06	17.88	25.37	21.41						
Propping.....	2.09	1.63	1.42	1.68						
Cleaning up orchard.....	.74	.01	.45	.16						
*Applying fertilizer or manure.....	2.09	1.89	1.90	1.95						
*Hoing around trees.....	.74	.62	.61	.65						
Miscellaneous labor.....	.72	.65	.61	.66						
Total cultural labor cost.....	\$ 80.61	\$ 75.71	\$ 76.08	\$ 77.21	\$.177	\$.187	\$.146	\$.168		
Interest on operating expense to harvest.....	\$ 4.10	\$ 3.93	\$ 4.15	\$ 4.05	\$.009	\$.010	\$.008	\$.009		
Total cost ready to harvest, excluding interest on land.....	\$ 170.22	\$ 165.38	\$ 175.32	\$ 170.24	\$.374	\$.408	\$.337	\$.370		
Total cost ready to harvest, including interest on land.....	230.20	226.14	236.48	230.92	.506	.558	.454	.502		

Apples, Yakima District; Orchards Containing Filler Trees (Continued)

	Costs per acre				Costs per box			
	1926	1927	1928	3-yr. av.	1926	1927	1928	3-yr. av.
Harvesting costs:								
Hauling shook.....					\$.005	\$.005	\$.005	\$.005
Picking.....					.086	.076	.083	.081
Hauling in and out of orchard.....					.026	.023	.020	.023
Hauling to warehouse.....					.030	.021	.020	.023
Supervising harvest labor.....					.001	.006	.004	.004
Packing (labor and material).....					.402	.423	.399	.408
Total harvesting costs.....	\$250.07	\$224.55	\$276.37	\$249.95	\$.550	\$.554	\$.531	\$.544
Interest on operating expense during harvest.....								
Total cost delivered at warehouse, excluding interest on land.....	\$ 7.50	\$ 6.74	\$ 8.29	\$ 7.50	\$.016	\$.016	\$.016	\$.016
Total cost delivered at warehouse, including interest on land.....	\$427.79	\$396.67	\$459.98	\$427.69	\$.940	\$.978	\$.884	\$.930
Total receipts.....	487.77	457.43	521.14	488.37	1.072	1.128	1.001	1.062
Net profit.....	\$444.44	\$638.44	\$555.35	\$555.00	\$.977	\$ 1.574	\$ 1.067	\$ 1.207
Net loss.....	43.33	181.01	34.21	66.63	.095	.446	.066	.145
Total cash outlay.....	\$386.58	\$355.59	\$414.67	\$385.08	\$.850	\$.877	\$.796	\$.837
Total depreciation charge.....	19.12	20.55	22.79	20.94	.042	.051	.044	.046
Total interest charge.....	82.07	81.29	83.68	82.35	.180	.200	.161	.179

¹Includes the labor of the operator, his family and his teams as cash outlay.

